INTERAVIA

REVIEW OF WORLD AVIATION

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IN THIS ISSUE

If Peace DID Break Out...

Recent aerodynamic advances

VOLUME X **12** DECEMBER 1955

New Queen of the skies

specifies Goodyear tubeless tires

SOON TO BE placed in transoceanic service by leading airlines throughout the world, the new Douglas DC-7C deluxe transport will pack 13,000 horsepower and 139,000 pounds of gross weight.

And—as have many of the world's fastest jets and largest airliners—this new queen of the skies also has specified Goodyear Tubeless Airplane Tires and Wheels for its main landing gear.

The success and acceptance of Goodyear Tubeless Tires has been due, in a large measure, to a multimillion dollar investment made by the company in equipment which "triple-tempers" Nylon cord by an exclusive process.

THIS CORD—CALLED "3T" NYLON—is the secret of a superbly strong tire body which is inherently airtight, a truly *tubefree* tire which carries the highest tire-loading without the loss of air pressure.

As a result, Goodyear Tubeless Tires are able to offer weight-savings of 40% of conventional tube weight—actually *run cooler* than tires with tubes!

If you would like more facts on the equipment *more aircraft land on than any other make,* we cordially invite you to write.

For information on these and other famed Goodyear Aviation Products, write the Goodyear office in Buenos Aires, Argentina; Sydney, Australia; Sao Paulo, Brasil; Cali, Colombia; Havana, Cuba; Wolverhampton, England; Cologne, Germany; Calcutta, India; Djakarta, Indonesia; Tokyo, Japan; Luxembourg, (Grand Duchy); Mexico D. F., Mexico; Wellington, New Zealand; Panama, R. P.; Lima, Peru; Port Elizabeth, South Africa; Stockholm, Sweden; Caracas, Venezuela; or The Goodyear Tire & Rubber Export Company, Akron, Ohio, U.S.A.

GOODYEAR
AVIATION
PRODUCTS

INTERAVIA

Review of World Aviation

Volume X | No. 12 | December 1955

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Front Cover.

The Spirit of Geneva... *central block of Geneva's Palais des Nations, where the first West-East talks on mutual arms inspection from the air took place.*

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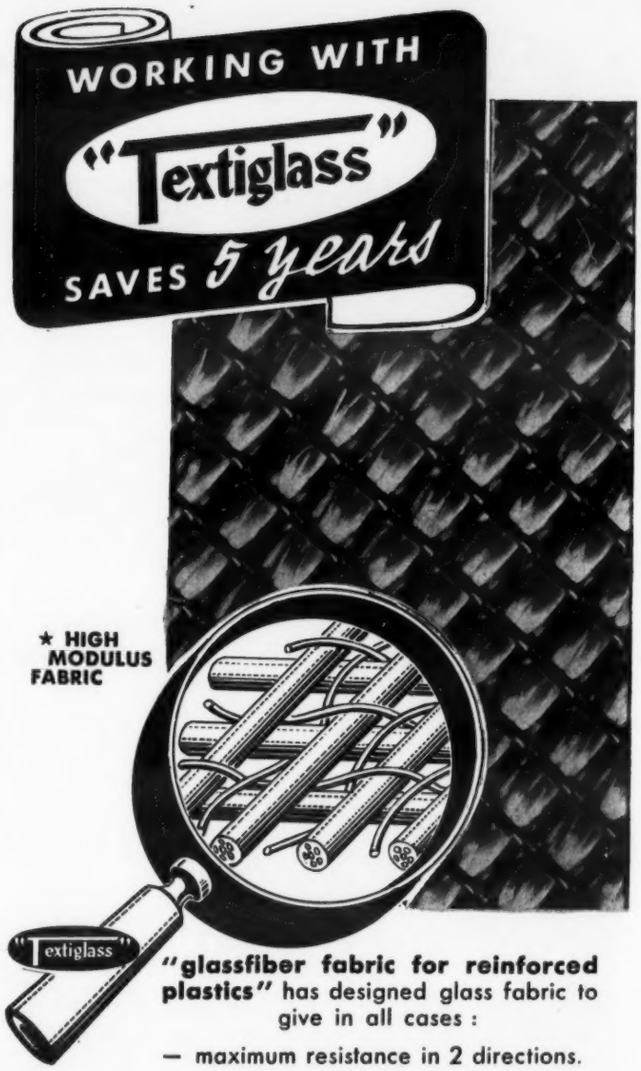

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★ DOCUMENTS AND SAMPLES ON REQUEST

JAYBERT

Around the World

Airlines Order U.S. Jet Transports

Commercial aviation moved toward the new jet air age recently with the announcement by several U.S. airlines of the purchase of Boeing 707 or Douglas DC-8 jet transports to go into service between 1958 and 1960.

As this is being written Pan American World Airways has ordered 20 Boeing 707s and 25 Douglas DC-8s, while United Airlines has bought 30 Douglas DC-8s. American Airlines has ordered 30 Boeing 707s and National Airlines has announced the purchase of 6 Douglas DC-8s. Braniff International Airways and Eastern Air Lines have said they will purchase quantities of either Boeing or Douglas jets, and similar announcements by several other major airlines are expected soon.

The new jet airliners, to be faster and larger than any other transports now offered by any other manufacturer in the world, will cruise at more than 550 m.p.h. and will be able to carry well over a hundred passengers. They will fly non-stop from New York to Paris in 6½ hours.

Four turbojet engines will power each transport. Two models of Pratt & Whitney Aircraft engines are being ordered, the J-57 rated at 10,000-pounds of thrust, and another twin spool, axial flow engine of even greater power. The J-57 engine has been in service since 1953 on the fastest U.S. military aircraft.

DOUGLAS DC-8 jet airliner is newest in world-famed series of Douglas transports. The DC-3, also known as the Dakota, was the most widely used transport of airlines all over the world. Many major airlines, both in the U.S. and in Europe, now fly Douglas DC-4s, DC-6s and DC-7s. The new DC-8 will use four Pratt & Whitney Aircraft turbojet engines.

with United Aircraft

BOEING 707 jet airliner has been flying for more than a year in prototype form. Boeing has built more large jet aircraft than any other manufacturer, including the huge B-52 for the U.S. Air Force, which also uses Pratt & Whitney Aircraft jet engines. Both the Boeing and the Douglas will set new standards of performance in commercial air travel.

NEW HELICOPTER FLEET of 7 large Sikorsky 12-passenger S-58s has been ordered by New York Airways. The new helicopters will go into service in 1956, augmenting the airline's present fleet of 5 Sikorsky S-55s. A spokesman for Sabena Belgian World Airlines has announced that his company is also considering the early purchase of a quantity of Sikorsky S-58s. Other countries are also discussing acquisition of the new helicopters.

WATER, SNOW, SAND OR ICE operations are possible for this ground-based U.S. Air Force C-123 transport with special water-ski landing gear. Hamilton Standard reversible propellers give a braking action and provide unusual flexibility in ground and water handling. This version of the C-123 was designed by Stroukoff Aircraft Corporation, New Jersey.

UNITED AIRCRAFT EXPORT CORPORATION *East Hartford 8, Conn., U.S.A.*

European Offices : 3/5 Warwick House Street, London SW1, England

PRATT & WHITNEY AIRCRAFT *Aircraft Engines*
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Lockheed designed and produced the first operational jet airplane in the U.S. more than ten years ago. Since that historic day, Lockheed has built over 7,000 jet-powered airplanes—more than any other company in the world.

Lockheed's latest proof of leadership is the exciting new Lockheed Electra—*America's first prop-jet airliner*—now in production for delivery to the world's leading airlines.* In the pace-setting Electra, surging jet power is combined with proven propeller dependability and economy—to whisk passengers to their destinations in luxurious comfort and quiet up to 100 miles per hour faster than any airliner presently in service!

* Already purchased in quantity by American Airlines and Eastern Air Lines.

C-130 HERCULES, NEW PROP-JET COMBAT CARGO PLANE—Husky brother of the Electra. A 62-ton carryall, to transport men and materiel farther, faster and at less cost than any other plane! Now in production at Lockheed's Georgia Division, U.S. Government Aircraft Plant No. 6 at Marietta. As shown, a huge 5,000-gallon gasoline tank-truck can be driven up the ramp into the cavernous interior of a C-130. In background, Lockheed-built B-47 jet bomber.

NEW JET-POWERED VERSION OF SUPER CONSTELLATION. Achieved by substituting prop-jet power for piston engines—a remarkable increase-in-speed transformation made possible by the extremely rugged construction and advanced basic design of the time-tested Lockheed Super Constellations. Result: the fastest propeller-driven airliner in the world! Designated the C-121F by the U.S. Air Force, and the R7V-2 by the U.S. Navy, these prop-jet Super Constellations are now undergoing exhaustive official tests.

T2V-1, FIRST CARRIER-BASED JET-POWERED TRAINER Evolved for the Navy from a series of jet planes inspired by the renowned Lockheed F-80 Shooting Star of 10 years ago. The Lockheed T2V-1 (above) has won deserved acclaim as the world's safest jet airplane.

F-104, STILL-SECRET SUPERSONIC JET-POWERED FIGHTER. (Photograph not yet released.) A high-ranking USAF officer said of the F-104, "This is a fighter pilot's dream. We feel confident that it is the fastest, highest-flying fighter in the air, anywhere."

THE BRIGHT FUTURE OF FLIGHT. Virtually no limit is in sight as to speeds, distances and economies which will be possible in tomorrow's air travel. Rocket power, ram-jet engines or nuclear energy will thrust transports around the world at incredible speeds while passengers enjoy undreamed-of comfort. At Lockheed's Missile Systems Division and at other Lockheed research centers, scientists already are deeply engaged in projects involving these and other new sources of power for future flight.

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LOOK TO LOCKHEED FOR JET LEADERSHIP, TOO

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IN THE FRONT RANK OF EUROPEAN

ELECTRONIC MANUFACTURERS

VAPOTRONS

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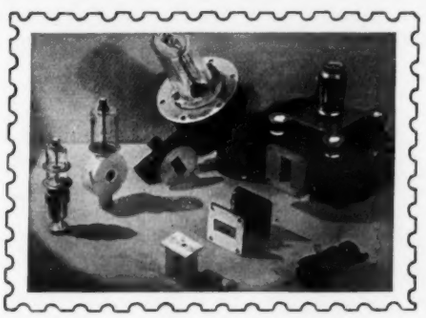
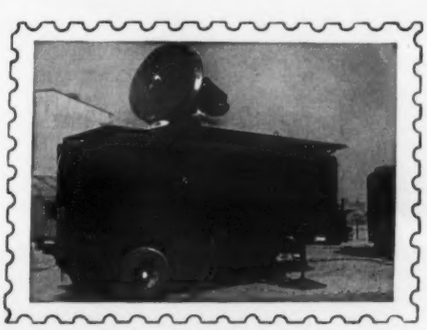


VHF TUBES

PORTABLE TRANSMITTER-RECEIVERS

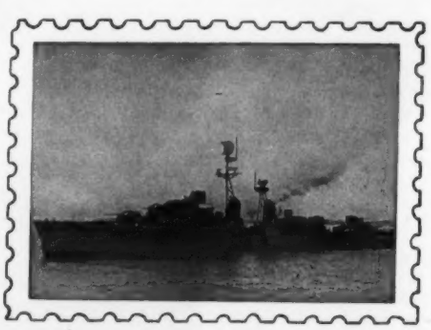
G.C.A. EQUIPMENT

RADIO-COMMUNICATIONS



AUTOMATIC RADAR

High-power
RADAR



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Ready for the Races in the Alpes vaudoises.

Oh boy ! What a view on the Mont-Blanc (highest peak in Europe) and the French Alps. Shot from the Swiss Jura.

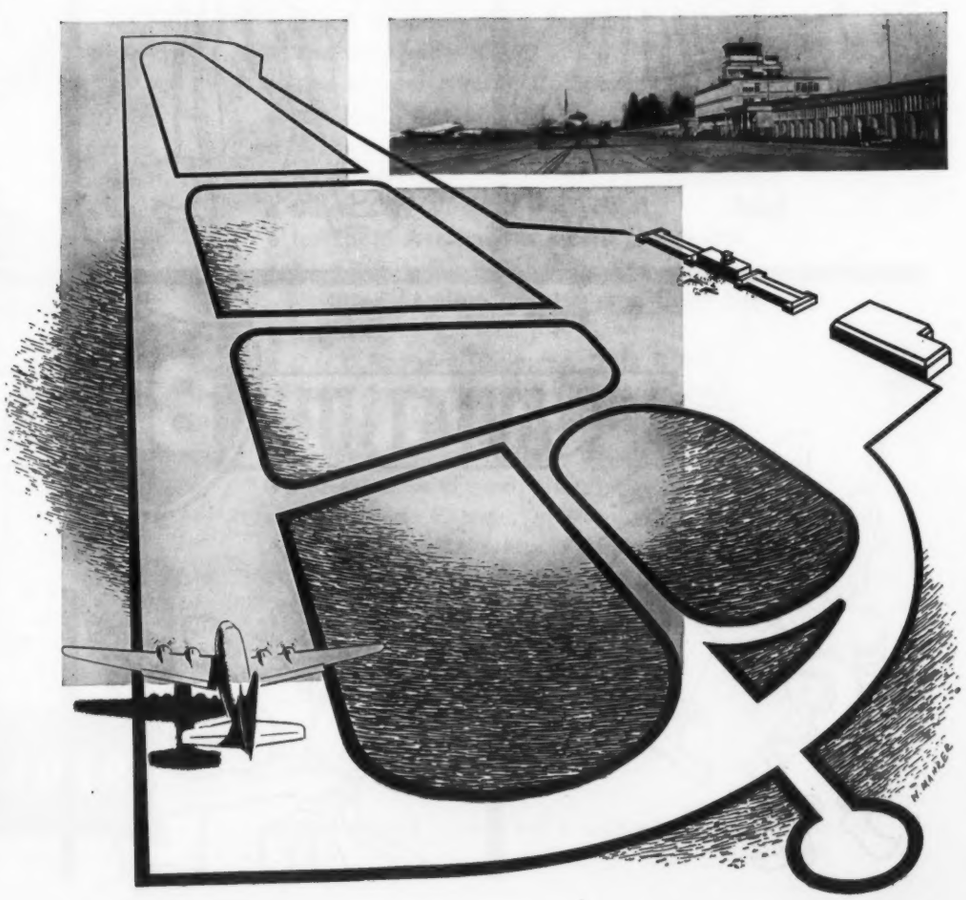
Can you imagine how happy these two people feel ? The " Suger cake " is the Matterhorn (Alpes valaisannes).

On the sunny side of good old Earth. This train will take you right into the heart of the Jungfrau (Bernese Oberland).

And here is the way to climb a mountain without getting tired. In front of the majestic Mont-Blanc, French Savoy.

GENEVA

INTERNATIONAL AVIATION CENTRE



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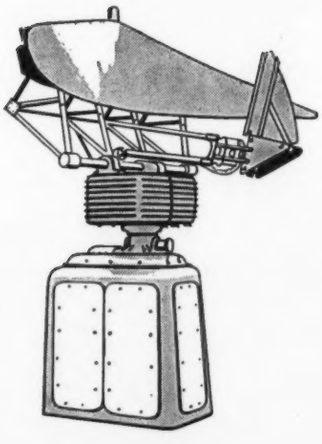
  (Caracas, Maiquetia, Puerto Cabello,
  Barcelona, Maracaibo)



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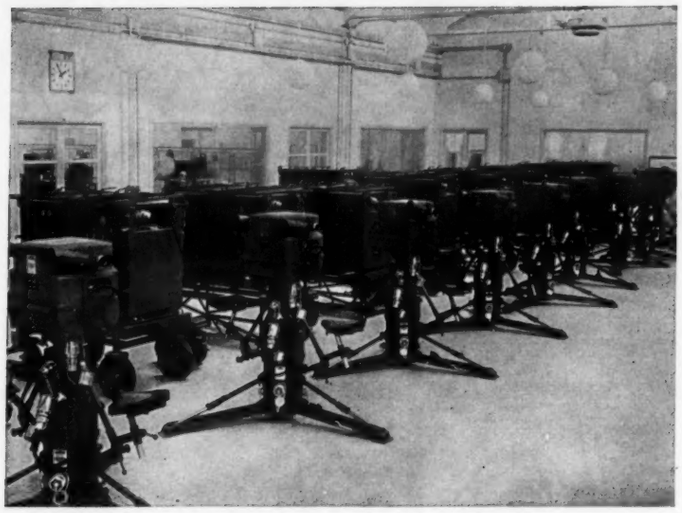

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Readiness for action

Operation in snow, rain, intense cold and heat without adjustments or abnormal maintenance work being required

High precision

Extreme lightness

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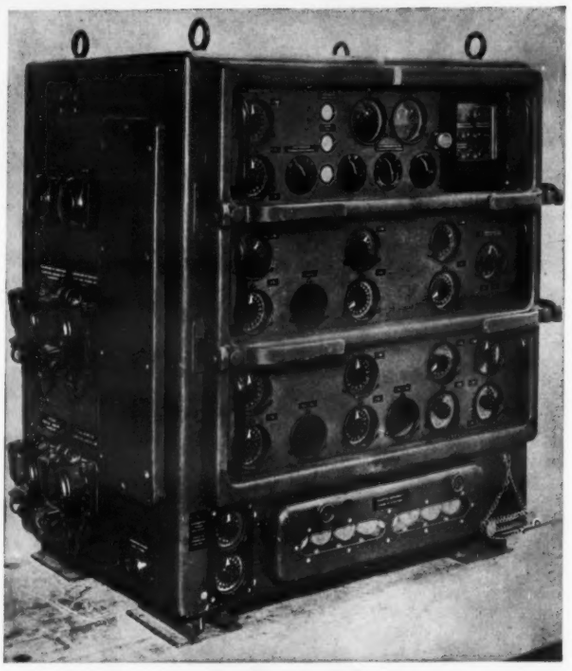
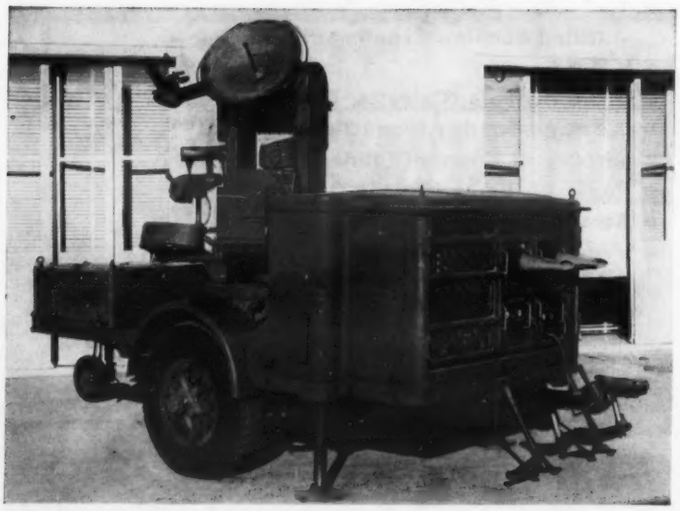


PARALLAX COMPUTER

between search and fire control radar



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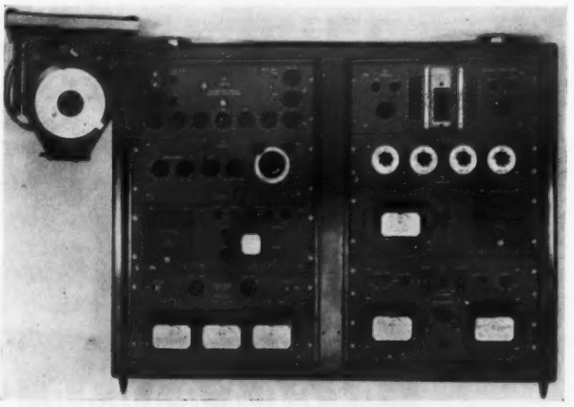

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ROYAL NETHERLANDS AIRCRAFT FACTORIES FOKKER

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Pye Telecommunications announce a

NEW TWO-WAY RADIO EQUIPMENT

Demonstrations of a new equipment, designed in Cambridge, have been given in London recently to representatives of Police and Fire Services, Local Authorities and Industrial Organisations. This equipment has been designed to defeat the chronic shortage of two-way radio channels.

Known as the Pye "Ranger", it is the solution to the frequency shortage which is ham-stringing mobile radio users in Great Britain!

The new equipment operates on a channel spacing of only 25 Kc/s—a quarter of the customary spacing—thus potentially quadrupling the number of mobile radio channels. Robust construction, excellent performance and carefully selected components make it capable of operating under arduous conditions and in any weather.

This mobile radio is designed for fitting in the dashboard of ordinary cars and vehicles. The price of the equipment, notwithstanding its many-times improved specification, is approximately the same as that of earlier equipments which it now replaces.

Please write for full details

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Succès d'hier qui se confirme...

FORTY "NORÉCRIN" FOR SWITZERLAND

A large Zurich firm, whose activities cover flying training and charter operations, has just placed an order for ... « Norécrins » wi... Nationale de ... Aéronaut...

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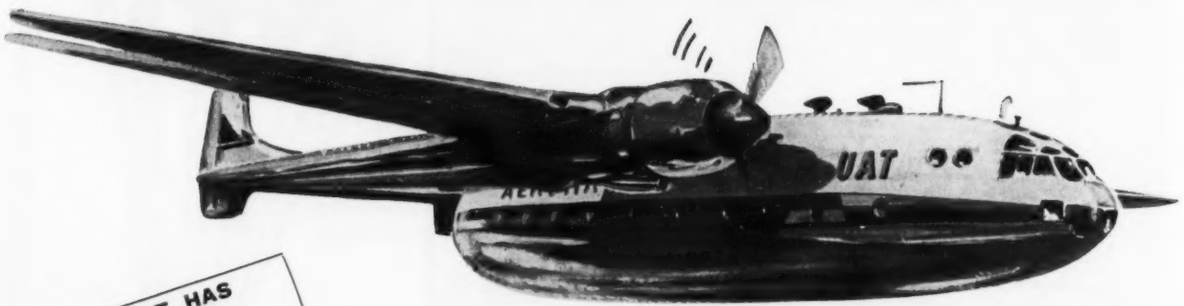
Même origine...

NORATLAS

... même succès



U.A.T. HAS CHOSEN "NORATLAS"

After a successful trial period, the well-known French airline U.A.T. has ordered a number of Nord 2501s from S.N.C.A.N. for its African services.

Succès d'aujourd'hui qui s'affirmera...

Nacc

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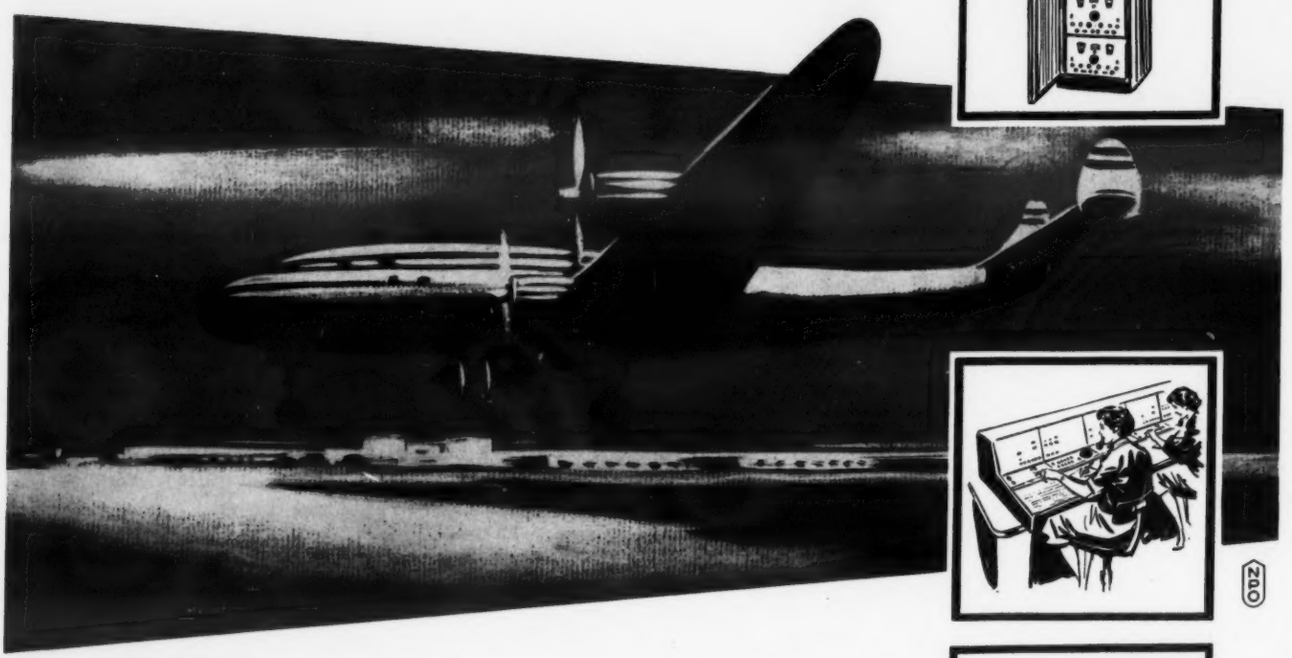
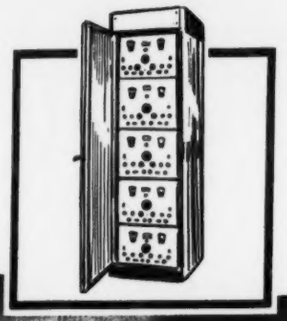
AMMUNITION OF ALL KINDS
COMBAT ROCKETS
FLARES AND SMOKE PRODUCERS

ROME (Italy) - 256, via Cavour

Philips' contribution to air traffic





PHILIPS' specialized equipment for airport communications covers an extensive field which includes everything from simple telephone handsets to fully automatic radio telegraph networks.
The wide range of apparatus called for by particular communication groups, such as VHF radio, point-to-point radio connections, intricate switching facilities, cable or overhead wire transmissions can be supplied and united by Philips into one smoothly operating overall system.

- *Private branch exchanges for airport telephony*
- *VHF radio equipment for air traffic control*
- *Communications transmitters and receivers*
- *HF radio transmission equipment for long and medium distances point-to-point telegraph and telephone communications*
- *Mobile two-way radio telephones for platform connections*
- *Automatic telegraph exchanges for inter-airport teletype traffic*

PHILIPS TELECOMMUNICATION DIVISION

PHILIPS Contribution to Air Traffic

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THE ONLY FRENCH ALL-WEATHER FIGHTER
WHICH IS BEING MASS-PRODUCED
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SUPERSONIC
JET
FIGHTER

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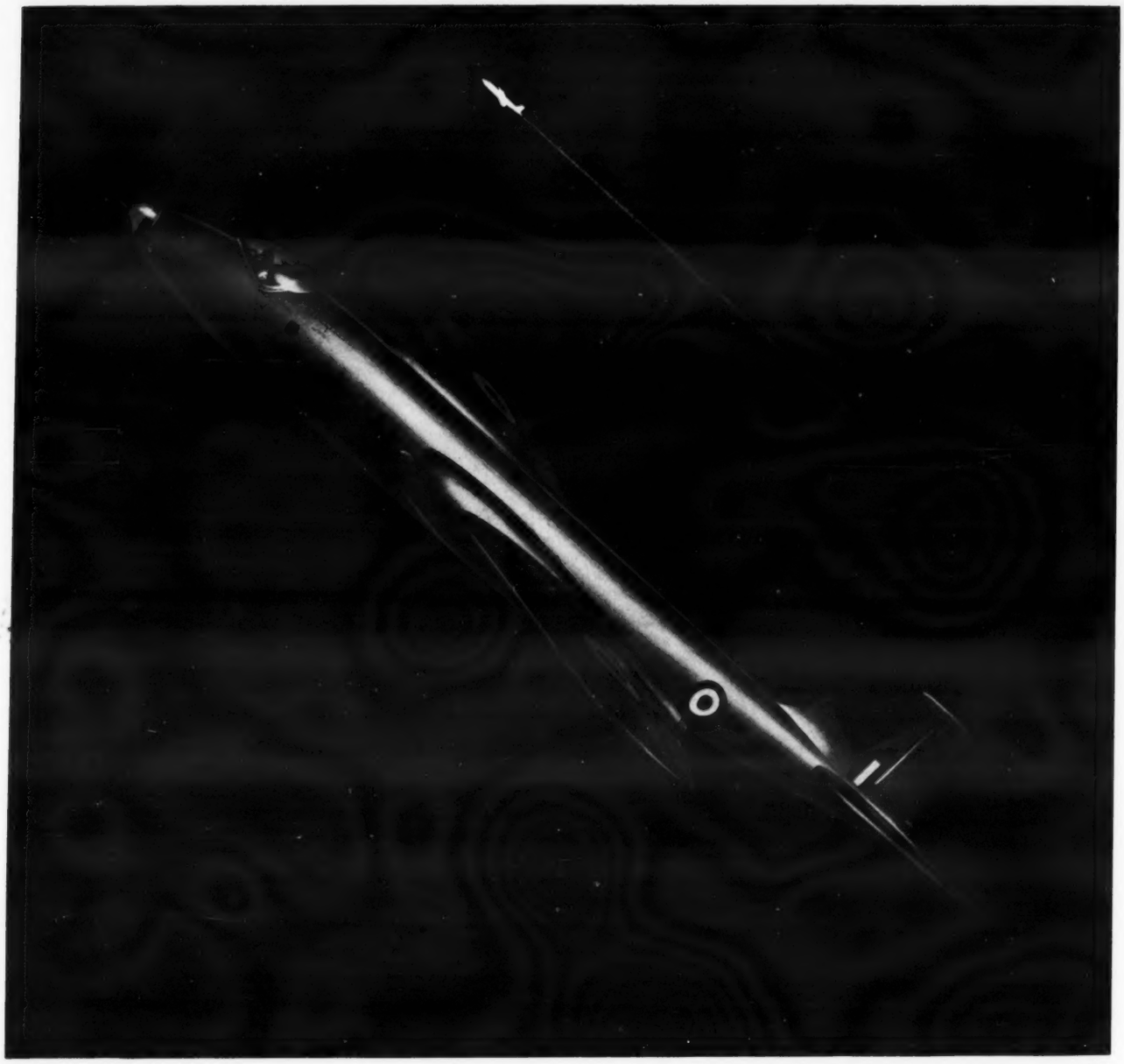

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INTERAVIA

Deadline Notes

No. 12, 1955

N.A.T.O. MINISTERS TO MEET

The Foreign, Defence and Finance Ministers of the 15 North Atlantic Treaty Organization countries will meet in Paris from December 15th to 17th, it is announced by N.A.T.O. Headquarters. The Ministers will discuss the budget for next year as well as policy matters.

JOINT HEADQUARTERS FOR BAGHDAD PACT POWERS

The first meeting of the Baghdad Pact members - Iran, Iraq, Pakistan, Turkey, Britain - decided to set up a permanent Sub-Committee of Deputies and a Headquarters Organization in Baghdad, including a Secretariat and a permanent Military Committee. Britain was represented at the conference by Foreign Secretary Harold Macmillan and Chief of the Imperial General Staff Sir Gerald Templer. The latter will be one of the members of the Military Committee.

SOVIET-BRITISH AIR AGREEMENT SIGNED

The Soviet Union and Britain signed an air agreement on November 19th laying the basis for possible commercial flights between London and Moscow, it was announced in a Soviet communiqué. The agreement was signed by Lord Douglas of Kirtleside, Chairman of British European Airways, and Marshal Zhavoronkov, Russia's Director-General of Civil Aviation and head of the Soviet airline Aeroflot. Although terms of the pact were not made public, the official communiqué described it as an "agreement on commercial collaboration in the field of civil aviation". It is understood the agreement involves mutual acceptance of round-trip airline tickets between the two capitals, with coordination of flight schedules at Helsinki, Vienna and Berlin. Landings of British aircraft in Moscow and Russian aircraft in London have not yet been agreed upon. It is expected, however, that the Russians would be interested in such a scheme as soon as they complete four-engine aircraft with longer ranges than their present twin-engine Ilyushins.

DEATH SENTENCE DEMANDED FOR AIRCRAFT SABOTEURS

Following the bomb explosion which caused a United Air Lines aircraft to crash near Denver, Colorado at the beginning of November, killing all 44 occupants, Senator Warren G. Magnuson, head of the Senate Interstate Commerce Committee, and Congressman Kenneth B. Keating announced that they would seek early Congressional approval for the introduction of the death penalty for sabotage resulting in loss of life on aircraft or trains.

AUSTRALIA AND JAPAN HOLD AIR TALKS

The clause in the San Francisco Peace Treaty permitting Qantas Empire Airways to operate to Japan expires in April 1956. Negotiations have therefore opened in Tokyo between Japanese and Australian Government officials for a new civil aviation agreement.

FRENCH NAVY TESTS ALOUETTE HELICOPTER

Operational testing of the first pre-production SE.3130 Alouette helicopter has begun at the French Naval Air Service base of Saint Raphael. A series of endurance tests covering 500 hours of flying is to be completed before the end of the year, and delivery of the first production batch will begin next March.

FIAT F-86Ks FOR ITALY'S 1st AIR BRIGADE

A first batch of Fiat F-86K jet fighters built by Fiat under North American licence has been moved to Treviso base and handed over to the re-commissioned 1st Fighter Regiment. When deliveries are complete the Regiment is to be renamed 1st Air Brigade.

UNITED STATES SEEKING SHORT-RANGE AIRCRAFT

Aviation experts concerned with finding a suitable aircraft for the growing U.S. local air carrier service system foresee a possible $75,000,000 procurement programme with a sizeable portion going to European firms. In the past few months seven of the thirteen U.S. local service airlines have dispatched officials to firms in Europe to study chiefly the Fokker F.27 Friendship (which has recently begun flight tests), as well

* From INTERAVIA's world-wide news service, including INTERAVIA AIR LETTER, the daily international aviation news digest. — No part may be reproduced without written permission.

as the Hurel-Dubois HD.32 and HD.321 and the Handley Page Herald. A replacement for the DC-3 is becoming more and more urgent, as traffic volume on local air services is increasing by leaps and bounds: in the second quarter of 1955 passengers rose by 32% and freight by 31% over the corresponding period last year, and the third quarter is believed to have seen an even steeper rise.

COMPENSATION FOR INDIAN AIRLINES

Eight Indian airlines are to receive compensation totalling 54,757,000 rupees ($11,500,000) for the nationalization of their operations. Only 10% of the compensation is being paid in cash, and the remainder in the form of bonds. The biggest sums are allocated to Air-India International ($5,815,000) and Air-India ($3,017,000).

SABENA BUYS EIGHT SIKORSKY S-58s

Sabena, Belgian Air Lines, whose helicopter division had carried a total of 50,262 passengers up to November 15th, 1955, has decided to order eight 12-seat Sikorsky S-58 helicopters for delivery in the spring of 1956.

AIR AUSTRIA

The Oesterreichische Studiengesellschaft für Verkehrsluftfahrt (Austrian Planning Company for Commercial Aviation) announces that the name of the new Austrian airline will probably be Air Austria. While K.L.M. and Scandinavian Airlines System are both showing interest in the formation of the airline, offers have also apparently been received from Russia which might enable the company to operate services to the northeast, possibly as far as Moscow.

BRISTOL-CANADAIR-CONVAIR TIE-UP

The Bristol Aeroplane Co., of England and General Dynamics Corp., New York, have confirmed that Bristol and two General Dynamics divisions, Canadair, of Montreal, and Convair, of San Diego, have concluded an agreement for long-term collaboration in their aviation interests. The first step will be work on a joint specification for a new "exceptionally long-range transport aeroplane . . . with genuine non-stop trans-Atlantic range . . ." The aircraft and engines are to be built on both sides of the Atlantic.

MITSUBISHI TO BUILD SABRES

North American Aviation Inc. and Mitsubishi Heavy Industries have signed an agreement on licence production of F-86 Sabre jets in Japan and the supply of technical assistance by North American. Parts for the first 70 aircraft will be supplied from the United States.

WORKSHOP BRIEFS . . .

The Fokker F.27 Friendship twin-turboprop commercial transport began flight testing in Amsterdam on November 24th. The aircraft was piloted by Fokker Test Pilot Burgerhout. - Originally it was feared that the first flight would be delayed by the death of Test Pilot Sonderman. * The first Republic F-105A fighter-bomber has begun flight testing at Edwards Air Force Base, California. Power plant: Pratt & Whitney J-57-P-25 of approx. 10,000 lbs. static thrust; production models of the F-105A will have the more powerful P&W J-75. * A more powerful, substantially bigger version of the Boeing 707 (longer fuselage, increased wing area; 4 x P&W J-75) is to be offered to air transport for 1959-60. * Sikorsky hopes to have a civil version of the S-56 twin-engined helicopter ready by 1959-60. * Conway by-pass engines are believed to have been chosen definitely for the Handley Page Victor V bomber. * The squadron version of the Saunders-Roe SR.53 fighter (turbojet plus rocket motor), the prototype of which is scheduled to fly early in 1956, is expected to be capable of speeds of Mach 2+. * According to unconfirmed reports Bristol is working on the development of a new super turbojet of 19,000 to 20,000 lbs. thrust. The name chosen is said to be Zeus. * The Bell X-2 rocket research aircraft has flown for the first time with engine running. Hitherto only gliding flights had been made. * Fairchild has developed a light-weight aircraft, designated M-232, with piston engine, for almost vertical take-off and landing: STOL = Short Take-off or Landing.

* * *

Peace and Christmas are and must remain inseparable ideas . . . Year by year an appeal goes out to the world to seek a basis for mutual understanding and fruitful cooperation. Deeply convinced that these hopes will one day be realized despite present difficulties, the Editors wish all their friends and readers

A MERRY CHRISTMAS AND A HAPPY NEW YEAR

Publisher and Editors

Talking of Peace

In deference to the "spirit of Geneva" that has been helping to decontaminate public opinion since the summer of 1955, the Editors chose as subject for the Christmas issue: *If peace broke out . . .*

This was not blind optimism; miracles were not to be expected. Who could have guaranteed that the Foreign Ministers Conference in Geneva would be carried through with the same *élan* and on the same grand scale as the meeting of the four Heads of State in July? Eisenhower and Bulganin were absent this time, and the boss admittedly sometimes has as easier task. Just the same, it would be wrong, despite the four Foreign Ministers' colourless final communiqués and their unceremonious departure from Geneva today, to speak of a "burial" of the Geneva spirit. It will prove to be indestructible.

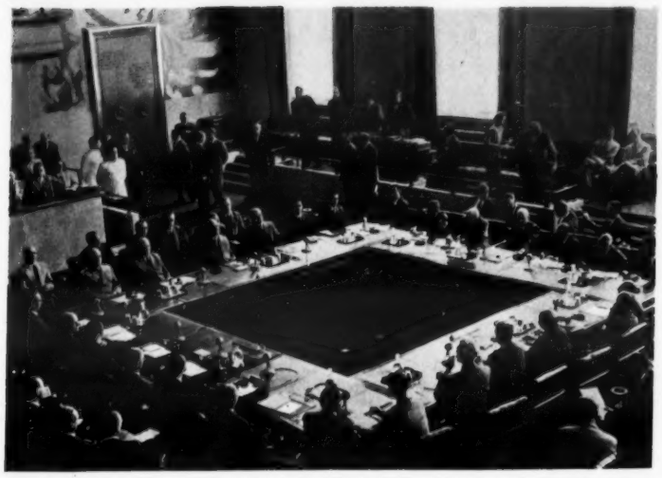
When the Editors first approached this month's subject, they asked their Washington correspondent for his views. He gave careful thought to the subject and discussed it with leading experts. His report is quoted in extract form below, as it incorporates not only the Geneva spirit but perhaps also the Washington spirit:

"Thirty Badger medium bombers with the insignia of the Soviet Air Force land at a dozen fields in the northern part of the United States. Five hundred Soviet reconnaissance cars equipped with short-wave radio debouch onto U.S. highways from ports on the Atlantic and the Pacific. One, perhaps two or three, 5,000 kilowatt radio transmitters, their antenna towers glowing at night with Soviet red stars, spring up near U.S. cities.

"These things sound fantastic. Yet they are envisaged in the exchange of views now going on between Washington and Moscow. The practical military men who are just beginning to consider the subject realize that some such picture must emerge if the ideas of 'mutual aerial surveillance' of Russia and the U.S., and 'stationing of inspection teams' in each country are to be realized.

"Actually, no one in the Air Force in Washington, indeed no one in the State Department, will acknowledge that workable plans for this eventuality are being drawn up. One State Department official, asked whether procedures for welcoming Russian inspection groups were being decided upon, replied cynically: 'The question is in the hands of the same committee which is studying possible international regulations to protect migratory white blackbirds.'

"Confronted with such ideas, the working levels of the Pentagon and the State Department have naturally been inclined to postpone any actual planning on the ground that the whole surveillance proposal would eventually be dropped. They suspect that the same attitude prevails among their opposite numbers in Russia.



From the "Conference of Smiles" to the "Conference of Separate Communiqués": the directives issued by the "Big Four" (left, Eisenhower, Faure, Eden, Bulganin and their delegations) in July 1955 ... were to have been worked into an agreement by the Foreign Ministers at the same conference table in October and November 1955. But the Ministers failed in this task. The right-hand picture shows Antoine Pinay, Norman Macmillan, Viachislav Molotov, John Foster Dulles and their staffs.

"In the U.S., high political and legal barriers to 'mutual inspection' cannot be overlooked. Suppose an agreement with Russia is worked out. If it comes in the form of a treaty it would have to be approved by the Senate. Suspicious isolationist Senators from the Middle West would be hard to win over. The same political traditions which kept the U.S. out of the League of Nations still guide many Senate votes.

"Congress would have to amend the Espionage Act to permit the Defense Department to hand over vital information to the Russians. U.S. treaties of mutual defense with other nations would have to be reconsidered. The N.A.T.O. charter alone might be called into question, for it provides that a conference of member nations must be called if, in the opinion of any one of them, the territorial integrity or the security of the group is threatened. Russian planes flying over the U.S. might certainly be considered a peril to territorial integrity.

"Behind the whole concept of mutual inspection as a deterrent to war is the conviction that the United States will use the hydrogen bomb and its strategic air power in case of hostilities."

"When *General Nathan F. Twining,* Chief of Staff of the U.S. Air Force, was asked for his views, he answered as follows:

'Adding up all these elements of air combat strength, you can see that we are ahead in our means to retaliate. However, we should be concerned about the Soviet rate of progress. It is somewhat like a foot race. At this point, we are ahead, but our competitor is catching up. This race is complicated by the fact that we do not know where the finish line is. As I see it, the race could end only in one of three ways: One—in a war. Two—in continued racing until one or both competitors stops running from sheer exhaustion. Three—in some form of disarmament.'

"It is a fact of world politics today that the third solution is being earnestly sought. Whether it arrives through the medium of the Eisenhower-Bulganin proposals remains to be seen.

"Perhaps Soviet planes *will* some day land in the U.S. and Soviet reconnaissance cars will take to the U.S. highways."

*

Such is the rough outline which Eisenhower and Bulganin sketched in Geneva in July 1955, and which Dulles and Molotov—with their spectacles and pince-nez—were perhaps unable to see quite so clearly in November. But this, it should be repeated, is not decisive for the final outcome of all conferences under the sign of the "spirit of Geneva."

What the situation would be if peace *still* broke out is described in the following pages. There is little to add.

However, it should be recalled that the heart and brain of the Russian empire lie closer to Europe than to Asia, even if Russian propaganda does from time to time beat the Asiatic drum. It should not be forgotten that the earth's population is growing from minute to minute, and that the rate of increase in the Far East is much higher than in the West, including the heart of Soviet Russia itself. Though such statements may appear to be platitudes, they are not likely to leave the men in the Kremlin entirely cold when it comes to the twentieth century's final decision.

*

After all, it is not the first time in history that peace or disarmament conferences have not succeeded at the first attempt. In an open letter to the delegates to the Lugano peace congress in September 1872—shortly after the end of the Franco-Prussian War, then considered of major importance to the world—*Victor Hugo* wrote:

"Dear Fellow Europeans,

"Our age is suffering the effects of war. Its sinister legacy threatens to compromise our whole civilization. Frightful hatred darkens the future. It seems a bad moment to talk of peace, but it has never been more necessary to do so.

"... We shall see a United States of Europe, which will crown the Old World just as the United States of America crown the New World ... We shall see countries without frontiers, trade without customs barriers, transport without obstructions ... the free world without oppression and ... mutual understanding without hatred."

Victor Hugo did not live to see all this. But after the United States of America, the first half of the twentieth century saw the Union of Socialist Soviet Republics, the United Nations and other movements. And one day, when the United States of Europe has come into being, such questions as the reunification of Germany will fall into place as of secondary importance.

On this note ... Happy Christmas! *EEH*

If Peace DID Break Out...

What would become of Western defence and N.A.T.O.?

BY ANTON HUBER, GENEVA

At the "summit" talks in Geneva last July the Four Powers strove to replace the "peace through fear" by a state more attractive to world opinion. Although the atomic *status quo* provides the best guarantee that nuclear weapons will not be used, the public, and a good number of "experts", do not understand that atomic air weapons—even if distributed unequally on either side of the Iron Curtain—safeguard its security because they ban any major trial of force.

Combined with the air arm, which is itself in a state of rapid evolution, the new explosive has revolutionized the conditions of peace and war to such an extent that there are few politicians today capable of envisaging the policies and diplomacy of the Hiroshima age.

Of the four projects outlined in Geneva last July and further elaborated since then in letters, statements or negotiations, only two—the American and the Russian—were based on a clear recognition of the new forms of war. The British plan feigns to ignore the character of an atomic conflict and proposes a sufficiently conventional solution to the security problem to be widely understood and hence appreciated by world opinion. As for the French proposal for financial limitations on armament, taken out of the dusty files of a past epoch, it may still have some value in the eyes of a public made up in essentials of taxpayers.

The Eisenhower plan was inspired by the full realization of the new threat hanging over the world: the surprise atomic attack capable of breaking the back of the most powerful adversary within a few hours. If surprised in the midst of its peacetime activities and if the atomic sledge hammer blow were judiciously applied, the victim of such an aggression might perhaps still have the means of retaliating but not the will or the desire to retaliate, so violent and decisive would have been the blow it had received. Bilateral inspection and control may appear effective against such a "national assassination". Moreover, since her forces are numerically greatly inferior to those of the Communist bloc, America cannot seriously envisage atomic disarmament or participate in the "peace offensive" except by proposing a form of control that would make it more difficult to prepare a surprise atomic attack. But the plan has its critics on both sides:

— It would operate too obviously in favour of the United States, as the Russians already can easily obtain information on the United States' military activity, whereas the Pentagon now knows little about its mysterious adversary and would thus gain a flood of information.

— It might not be effective in view of the small number of A-bomb carriers required for an attack, even if the targets of the attack are spread over half the globe.

— Nobody on the senior staffs of either side really believes that such an aggression will take place, because of the risks to the aggressor. In this case "Ike's" proposals are of value only if control and inspection are equally effective in revealing preparations for a localized conflict of the Korea type.

Both big Powers feel themselves threatened... Left a warning poster of the U.S. Continental Air Defense Command showing the possible approach routes for Russian *Bison* and *Badger* jet bombers attacking North America. (Over the Pacific they would use the "jet streams".) - Right, a possible Russian reply to the CONAD poster: there are no fewer than 150 U.S. Air Force bases around the Soviet Union from which U.S. bombers, primarily Boeing B-52s and B-47s, could launch atomic attacks. In addition, carrier-based jet bombers, such as the Douglas A3D, could be sent up from the U.S. Navy's many large aircraft carriers.

— Finally, and above all, how could the plan be realized if by chance the "Biggest Two" should agree to it without ulterior motives? All military installations, naval bases, airfields, barracks, depots, stores etc. would have to be open to inspection throughout the territory controlled by the two *blocs* or allied to one or other of the *blocs*. Hundreds of thousands of photographs would have to be taken and studied systematically at very brief intervals, so that the military life of the peoples engaged in this vast operation of mutual surveillance could be constantly scrutinized. And how easy it would still be, despite these efforts, to mount an atomic air attack. "The real solution," remarked a humorist, "would be to appoint a Russian as chief of staff to General LeMay in Strategic Air Command and put in an American as second-in-command of the Russians' long-range bomber force." And even then!

The Kremlin found an answer to President Eisenhower's offer. "O. K.," said Marshal Eulganin's famous letter in effect, "but let us extend control to all the military machinery of the two blocs"—which seems logical, but would annoy certain allies who are particularly sensitive as regards national sovereignty—"and above all," continued the Soviet statesman, "let us begin disarming by banning nuclear weapons." This is doubly astute: the ultimate goal is not the control of armaments but disarmament; everyone in the world would agree without hesitation to a ban on atomic weapons. But it must be remembered that without the A-bomb forces, which alter the whole balance of power and outplay large armies, there would be four hundred Russo-Chinese divisions facing less than fifty Western divisions. However, in the eyes of world opinion, the Russian counter-proposal has the advantage of aiming more directly at disarmament—and the consequent financial economies—rather than at the control of armaments with the additional expense it would entail.

Russian *Badger* twin-jet long-range bombers in a demonstration flight over Moscow.

It returns to the Russian statement of May 10th, 1955 to the United Nations Disarmament Commission and proposes a general plan based on the banning of nuclear weapons and reductions in conventional forces. The East, of course, has nothing to lose from such a proposal. It still retains the ability to mobilize mass armies, and no country in Europe could resist diplomatic pressure backed by such forces if it were no longer possible to threaten atomic retaliation. Moreover, if the American plan for control of the *use* of atomic air forces is not easy to enforce, the Soviet plan for a *ban* on nuclear weapons would also not be simple to implement. How could it be ensured that all atomic weapons were destroyed? How could their manufacture be prevented when the peaceful uses of atomic energy are so numerous and require the development of such closely related techniques? Within the framework of this form of control, it is obvious that countries with a liberal system of government will not receive from others the same guarantees as they grant.

*

From territorial neutralization to national neutrality

Without openly admitting it, the British plan shows one particular difference compared with the three others: it enables the question of West German rearmament to be reopened. When Anthony Nutting described it to the United Nations Disarmament Sub-Committee he spoke of a buffer zone along the Iron Curtain in which military installations and forces would be known to both sides. Being much less ambitious than Eisenhower's proposal, the Eden-Nutting plan could easily be applied. It would preserve the *status quo* in Germany and open West and East German territory to mutual inspection. It would provide no safeguard against a surprise atomic attack, but it would hamper the preparation of a localized conflict if one or other side wished to indulge in such a trial of strength. It would handicap Western Europe's defensive strategy, already lacking in depth, more than that of Eastern Europe which has a great land mass to fall back on. After the meeting of the United Nations Disarmament Sub-Commitee, the West announced its desire to reunify Germany, and the proposed controlled—or semi-demilitarized—zone was moved further east to an "Iron Curtain" running along the eastern frontier of a unified Germany. The present East Germany on the one side, and Poland and

The *Bison* four-jet long-range bomber, of comparable size to the U.S. Air Force's B-52, today forms the backbone of the Russians' longe-range bomber fleet.

Boeing B-52 *Stratofortress* long-range jet bomber of the U.S. Air Force's Strategic Air Command.

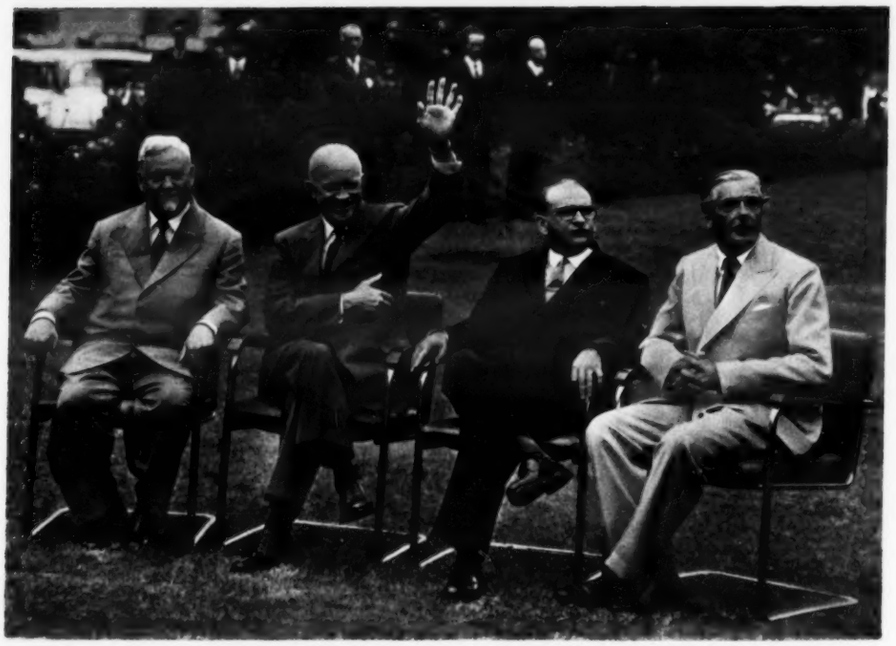
The U.S. Navy's Douglas A3D *Skywarrior* carrier-based jet bomber.

Czechoslovakia on the other should form a kind of semi no-man's-land, with a reduction in the armed forces stationed there and reciprocal control and inspection of these forces. But the preliminary condition, the unification of Germany, is as decisively rejected by Moscow as is the idea of a demilitarized zone on either side of the present Iron Curtain by certain Atlantic powers.

The French plan would be particularly difficult to implement for all countries, beginning with France herself. It is hard to see how, by reducing expenditure on national defence, she could renew her present arms equipment, most of which has been provided by the United States, and at the same time establish and arm the forces she needs in Africa. To reduce expenditure on the units allocated to N.A.T.O. for the defence of Europe would mean maintaining less than ten large land units and less than a thousand aircraft. The French military machine would then take on a purely symbolic character. M. Pineau told the National Assembly's Finance Committee that some 50,000,000,000 francs in supplementary military appropriations would be needed in 1955 and that next year this sum may rise to 100,000,000,000 francs. Moreover, because of differences in the standard of living and in the basic conception of military systems on the two sides, the financial limitations proposed by France would favour the Soviet *bloc* which—even if budgets were not faked—would obviously be able to obtain considerably bigger forces for sums equivalent to those spent by the Western countries on their defence.

Refuelling a U.S. Air Force Boeing B-47 *Stratojet* in flight.

The 60,000-ton aircraft carrier U.S.S. *Forrestal* (CVA-59) left the Newport News, Virginia, yards at the end of August 1955. The *Forrestal* is the first of the class of giant aircraft carriers of the same name, of which six have so far been laid down (*Forrestal, Saratoga, Ranger, Independence, Kitty Hawk* and CVA-64, the last-mentioned probably to be atomic powered). The *Forrestal's* length is 1,040 ft. and extreme width 252 ft. It is equipped with angled deck and four steam catapults, has a complement of 3,826 men and carries at least 100 aircraft (including jet bombers).



July 1955: The "Big Four" – Prime Minister Nikolai Bulganin, President Dwight D. Eisenhower, Prime Minister Edgar Faure and Prime Minister Sir Anthony Eden – during a break in the Geneva "summit" talks.

Nevertheless, these plans could be more or less coordinated and brought into harmony in a general plan for reducing tension based on a certain reduction of military expenditure, air and ground reconnaissance, total or partial demilitarization of a buffer zone, or even a special check on the manufacture of nuclear weapons. Meanwhile it is interesting to examine what would be the effect of each plan on present military organization and armament plans.

*

Safety by inspection

On the Western side, the American project is the only one which makes allowance for the new conditions which would arise in a possible future general war. It is based on two fundamental ideas:

— Resort to force by either of the "Biggest Two" is unthinkable unless one or other were prepared to launch an atomic air attack as a total surprise and were confident of being able to destroy the other's means of retaliation with a single blow.

— Because of the inequality of present conventional forces the Western world must base its security on the threat of atomic reprisals. This threat is effective only if the potential enemy is not certain of being able to destroy the means of such retaliation. If, however, he is deprived of the possibility of delivering a surprise attack, he cannot have this certainty, and the risk would become excessive.

The system of security envisaged by the United States President is based on two principles: control and inspection abroad, and warning and exploitation of the warning at home through a new military structure capable of acting on the information received on the adversary's intentions or acts of hostility. Enough has already been said on the subject of control and inspection. Ground surveillance by inspection teams would appear to be more effective than aerial photography, especially as it is doubtful whether the Russians would agree to air reconnaissance over their territory as long as Strategic Air Command exists. This brings us to one of the difficulties inherent in the Eisenhower plan. It implicitly foresees a second phase, that of disarmament, once the first, surveillance phase had reduced distrust and calmed the nations' fears. But the West could consider the first phase only under the shelter of its atomic air arm, whereas the East demands that if control and inspection are accepted they must be applied to conventional forces, and atomic air weapons must first be banned and destroyed.

If agreement cannot be reached on this essential point of mutual surveillance, it would still be possible to organize reprisal forces that could not be destroyed by a surprise attack. Military staffs on both sides of the Iron Curtain are obviously working towards this end, which can only be achieved by a combination of a variety of measures, such as:

— a strengthening of the warning services which keep watch for any signs of offensive action;

— the widest possible dispersion of the atomic retaliation forces, so as both to oblige an aggressor to employ a large offensive force and to render his operational task more difficult;

— security restrictions on news of normal activities and movements of strategic forces,

Disarmament specialists from West and East: Harold E. Stassen (left), special assistant to President Eisenhower on disarmament problems, in conversation with A. Sobolev, Soviet delegate to the United Nations Disarmament Sub-Committee.

Minister of State Anthony Nutting was spokesman in New York and Geneva for the British plan for demilitarized "buffer zones" (Eden-Nutting plan).

His colleague Jules Moch, French delegate, put forward a plan for limiting arms expenditure in West and East.

so as to keep the adversary in ignorance of the targets he should aim at and add uncertainty of success to the technical difficulties of such an attack;

— constant surveillance of the other side's aircraft movements through the combination of the most efficient electronic equipment and the human sight and hearing of ground observers.

Pending the general introduction of intercontinental ballistic missiles, it is not difficult to forecast what kind of air forces would be needed to escape a surprise attack. Aircraft speed and range must be increased and combined, to enable them to be stationed as far as possible from enemy bases. Electronic techniques will be developed so as to extend as far, as high and as low as possible the zone in which the adversary's aircraft movements can be detected.—Finally, the "Biggest Two" will mount a permanent radar guard along their closed frontiers.

Under such a deployment of new techniques and new organization of armed forces equipped to escape an atomic blow and to retaliate, neither side would have the means of preventing the other from engaging in a localized conflict of the Korea type. *Ground surveillance and inspection* could help to prevent preparation of a war of limited scope. But, as has already been seen, it is doubtful whether the American proposal will be accepted unless the United States makes concessions that would risk its own security and that of the whole Western world. The British plan on the other hand might provide a solution to the problem of localized conflicts. Surveillance and inspection would be easier to carry out in the "contact" zone. What is more, the "Biggest Two" could

DEFENCE EXPENDITURE BY N.A.T.O. COUNTRIES 1949-1953

The tables show that the N.A.T.O. states spent a total of more than $ 203,500,000,000 on collective defence during the five years 1949-1953. However, Western European countries contributed only 20 % of this total, while America provided 80 %. In practice the American share was considerably greater if the value of the equipment supplied free of charge under the mutual aid agreements is taken into account. Hence the only practical way to reduce defence expenditure would be to reduce the United States' share. A ten percent cut in European defence expenditure would produce a total reduction of only $ 600,000,000, or 1 % of the total for 1953.

N.A.T.O. DEFENCE EXPENDITURE ACCORDING TO REGIONS

(millions of dollars)

Region	1949	1950	1951	1952	1953	Total
Continental Europe	2,649	3,033	4,387	5,940	6,498	22,507
United Kingdom	2,181	2,377	3,217	4,371	4,729	16,875
U.S.A. and Canada	13,672	14,795	34,436	49,546	51,694	164,143
Total	18,502	20,205	42,040	59,857	62,921	203,525

N.A.T.O. COUNTRIES' DEFENCE EXPENDITURE

(round figures in millions of dollars)

Country	1949	1950	1951	1952	1953
Belgium	153	165	268	400	398
Canada	372	495	1,220	1,875	1,960
Denmark	52	52	69	98	129
France	1,369	1,597	2,517	3,705	4,146
Greece	54	65	111	82	92
Italy	481	564	731	833	768
Luxembourg	2	3	5	9	10
Netherlands	179	237	279	330	350
Norway	52	50	80	116	149
Portugal	50	53	55	60	70
Turkey	257	247	272	307	386
United Kingdom	2,181	2,377	3,217	4,371	4,729
United States	13,300	14,300	33,216	47,671	49,734
Total	18,502	20,205	42,040	59,847	62,921

APPROPRIATIONS FOR ARMS PRODUCTION

IN TWO REFERENCE YEARS

(millions of dollars)

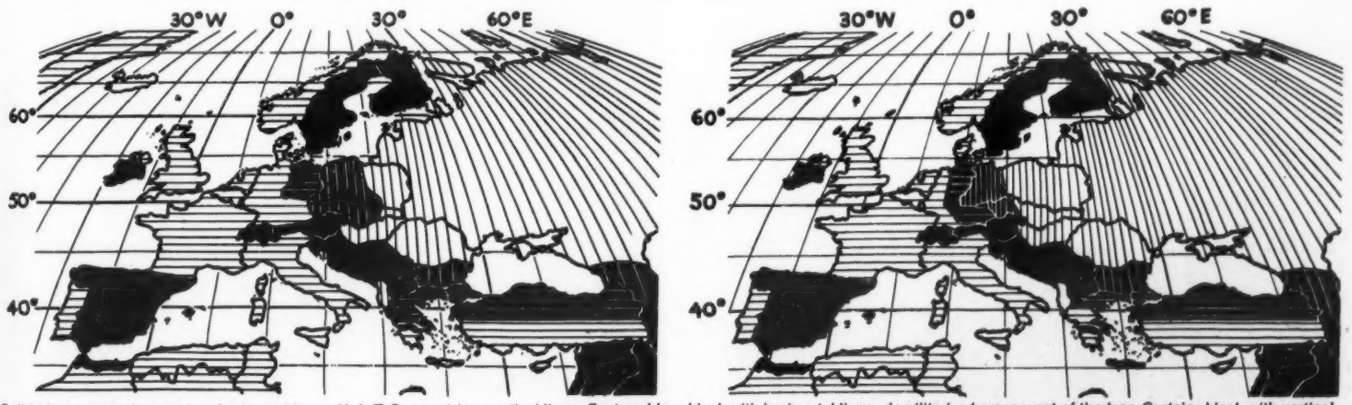
	1945	1953		1945	1953
Total N.A.T.O. defence budgets	18,500	62,780	Expenditure on arms production	3,000	25,000

Economic and financial aid and supply of free equipment

Canada: Canadian aid began in 1950. So far Canada has supplied 500 F-86 *Sabres* and large quantities of radar equipment and installations, minesweepers, ammunition etc. From 1950 to 1954 the value of equipment supplied was approx. $ 630,000,000. In addition, equipment to the value of approx. $ 220,000,000 was delivered during the 1954-55 fiscal year. Canada has also spent roughly $ 60,000,000 on training European aircrews.

United States: At the beginning of April 1954 the value of U.S. military equipment supplied to Europe was $ 15,000,000,000, to which must be added an additional $ 6,000,000,000 for equipment that was scheduled for delivery from 1954 on. Under the off-shore contracts system the United States had spent $ 1,727,000,000 up to the beginning of April 1954. This figure does not include the $ 388,000,000 of special funds allocated to France or the United States' aid for the war in the Far East. To provide a complete picture of the arms situation in Europe the effects of Marshall Aid should also be taken into account.

Two variants of a security plan for creating buffer zones: left the original British plan based on the reunification of Germany and calling for demilitarized zones to west and east of the Oder-Neisse line. Right, the buffer zones on either side of the present Iron Curtain (Elbe line) which might result from Russian opposition to a reunification of Germany. — In both cases the Central European buffer zones should be supplemented by similar zones in Southeast Europe and Asia Minor.



Solid black: neutral countries; horizontal lines: N.A.T.O. countries; vertical lines: Eastern bloc; black with horizontal lines: demilitarized areas west of the Iron Curtain; black with vertical lines: demilitarized areas east of the Iron Curtain.

agree, without running any great risk, to a limitation of their forces stationed in this zone and to the creation of a glacis between the two potential opponents. Under this system the powers equipped with atomic air weapons retain their ability—and accept the risk—of launching and hence of becoming the victims of a surprise atomic attack.

Three categories of nations

There is no mention in the British plan of surveillance or inspection at the source. The political disadvantage of the proposal is that it introduces a third category of nations. Formerly there were "pledged" nations and neutrals. In future there would also be nations politically and militarily pledged, but whose territory is placed under the surveillance of a potential enemy.

The British proposal is limited to Central Europe and places part of a reunified Germany under this type of control. It would be difficult not to extend its provisions to other contact zones, to reinforce Swedish, Austrian and Yugoslav neutrality, or place Greece and Turkey in the military no-man's-land. Admittedly, Poland, Czechoslovakia and Bulgaria, as a whole or in part, would also be concerned in such a demilitarization. But the cohesion of the satellites is naturally stronger than that of the Atlantic Allies, who are held together only by fear of Russian expansion which, though less obvious today, is no less formidable. Hence neutrality rather than surveillance of their military installations may be more tempting to the boundary countries that can still control their own fate. Thus Europe's whole military aspect would be modified. It is not even certain that the military vacuum thus created would not provide conditions for localized conflicts beginning with movements that the police forces could not control and gradually involving the intervention of ground forces stationed on either side of the contact and inspection zone. Each side would then aim at creating highly mobile air and ground forces capable of intervening successfully in the semi-demilitarized zone so as to restore a favourable state of affairs. There would not be disarmament, but a withdrawal of armed forces to either side of the strip of ground and air space under surveillance.

Turning to the French plan for a progressive limitation of military expenditure, it is clear that if the atomic *status quo* is prolonged a country like the United States can spend $40,000,000,000 to $50,000,000,000 a year on passive defence, dispersion of factories etc. If, however, this "atomic fear" is reduced and peaceful rivalry is achieved, part at least of these sums can be used for the development of the United States and the rest of the world. As regards the U.S.S.R., it can be assumed that nearly a quarter of the Soviet national income is devoted to military expenditure. If corresponding investments could be made in the productive sides of the economy, the Russian citizen's standard of living could be raised by 6 to 8 % a year, and in ten years reach the same level as many Western countries, thus removing one of the basic reasons for the serious differences between West and East. Similarly, the gross national income of the N.A.T.O. countries other than the United States and Canada is rising by an average of 3 to 5 % a year. If they could reduce their defence expenditure and increase their useful investment, their standards of living would rise rapidly.

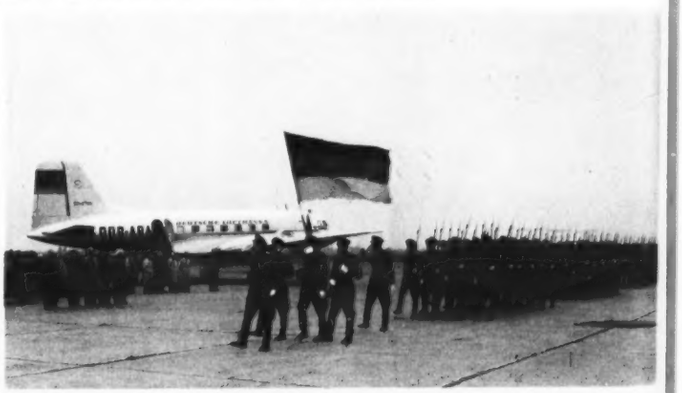
All agree on the advantages of reducing military expenditure and correspondingly raising civil investments. But what picture does an examination of the facts, especially of the situation in Europe, reveal? Lord Ismay's book on N.A.T.O.'s organization and achievements lists the thirteen member-countries' defence expenditure between 1949 and 1953. The European countries spent the equivalent of $11,000,000,000 on defence in 1953, and North America (United States and Canada) nearly $52,000,000,000, or nearly five times as

The West's New Offer to prevent surprise aggression

In exchange for the reunification of Germany and the inclusion of a united Germany in the N.A.T.O. defence system, the Western Three have offered to guarantee the Soviet Union. From the military point of view, such a guarantee would be provided by creating a semi-demilitarized and controlled zone on either side of a new "Iron Curtain" along the eastern frontier of a united Germany.

The main new proposal to prevent surprise attack, however, is for the establishment on either side of the (new) Iron Curtain of radar warning systems manned by personnel from the other side. For example, radar stations set up to the west of the Curand directed towards the west should be manned by Soviet personnel, and the stations to the east, facing east, should have personnel from the Western nations. From the practical point of view this would mean that the West's air raid warning zone would be pushed forward from the Elbe to the Vistula. For the East, however, there would be no change, since the Iron Curtain would be moved back to Germany's eastern frontier. The proposition underlines the importance which the Western Allies attach to radar detection of air raids and hence to all measures capable of reducing the chances of a surprise atomic attack.

In both West and East Germans march under the same black-red-gold flag . . . but under different rules. Left, a detachment of West Berlin alert police in normal marching step; right, a detachment of East German "Barracks People's Police" in Russian semi-goosestep (in background an IL-14 of the East German Lufthansa).



East and West Forces and Potential

By annexing Esthonia, Latvia and Lithuania and territory in Poland, Rumania, East Germany and Czechoslovakia, Soviet Russia had already added 25 million men to its population. Then the "political" absorption, without war, of the territory occupied by Soviet forces raised the number of people associated by force with her empire to nearly 90 million. The gross national product of these annexed countries represented at least 50% of the Soviet's wealth, and their military resources added another 30% to its armed strength.

Today, the U.S.S.R. controls 175 first-line land divisions of its own, plus more than 80 satellite divisions. These forces correspond to more than 6,000,000 men under arms, of which 4,500,000 form the land units. The number of combat aircraft that Russia can put into the air is estimated at 20,000. Modernization of flying equipment has been speeded up, and with their new versions of the MiG-15 and a supersonic fighter in the interceptor field, and various jet tactical bombers for light bombing work, the Soviet *bloc* air forces have no need to envy the Western air forces. Present Russian efforts are concentrated on the medium and heavy bomber units, of which the former are still equipped with obsolescent aircraft (Tu-4) and the latter are only in embryonic form. Within four years, the experts believe, the U.S.S.R. will have supplemented its short-range offensive and defensive air units with a powerful strategic force capable of flying non-stop half way round the world. As regards Naval forces, the Russian Admiralty continues to reject the aircraft carrier and has concentrated its efforts on a very large fleet of ocean-going submarines. Today experts estimate the number of heavy long-range submarines at between 350 and 400.

Out of this powerful force the U.S.S.R. has 22 divisions deployed in East Germany (to which must be added the equivalent of five large German units) and more than 3,000 aircraft. These are the forces aligned against the N.A.T.O. units in Central Europe. Behind these first-line forces, there are 60 more large units which could be deployed in support of the 22 divisions, and more than 300 major Russian and satellite units could be thrown in two weeks after the outbreak of a conflict.

In the face of these forces the West is seeking to set up a "safety cordon" sufficiently strong to prevent a military "excursion" and forcing a potential adversary to engage in extensive mobilization operations that would give the alarm. Here the famous atomic threat as a "deterrent to aggression" gains its full value, since it has been made clear that any attack on Europe would be answered by powerful atomic reprisals that no defence could stop.

This is the only possible policy in view of the disproportion between the forces on the two sides. On the one hand there are 255 divisions (175 Russian and 80 satellite) and 20,000 first-line aircraft, all concentrated in the Old World, directly facing less than 50 divisions and 5,000 to 6,000 combat aircraft in the West. Thanks to N.A.T.O.'s efforts and taking into account the tremendous human, industrial and economic resources of the United States, the North Atlantic Treaty members had more than five million men in all branches of the armed services mobilizable in 1954, counting the U.S. and British air forces stationed outside Europe. Though numerically inferior to the Russians, these forces can nevertheless balance the latter's power because of the atomic retaliation which any attack on them would automatically unleash.

The Western Allies' security plan calls for chains of warning radar stations on either side of the Iron Curtain, to be manned by personnel from the other side.

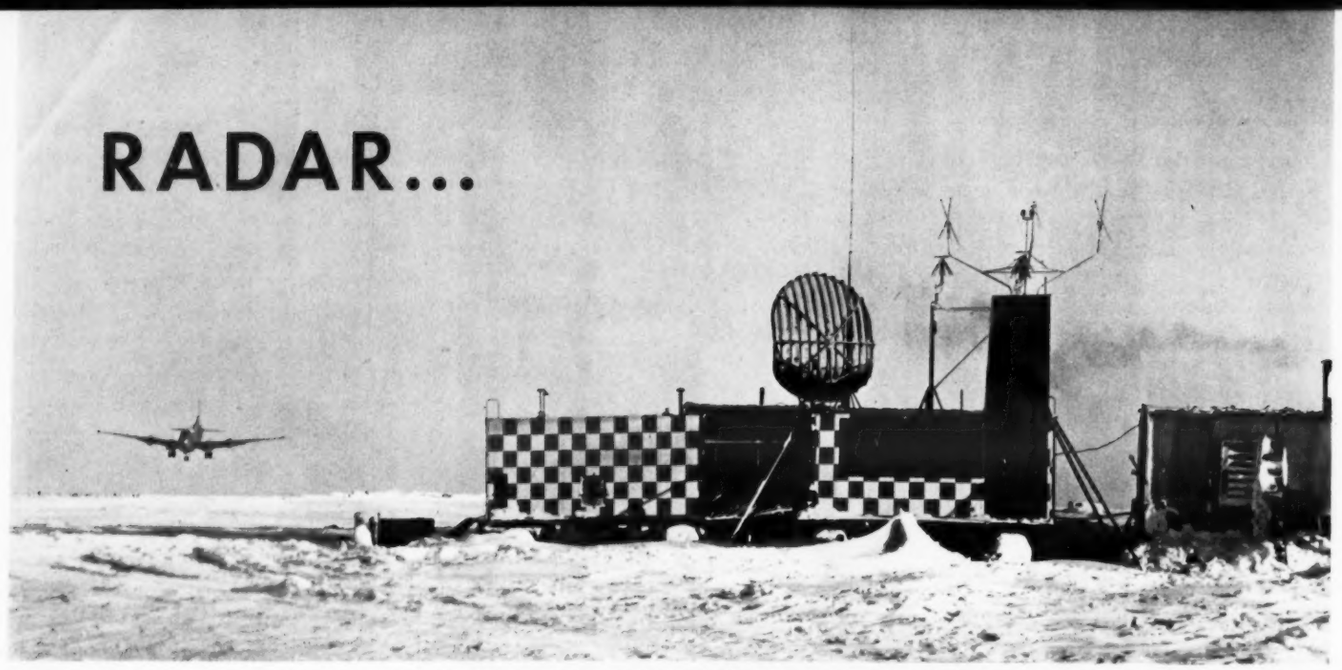
much. The $11,000,000,000 spent by the countries of Western Europe was enough on the whole to cover their expenditure on troops and military ground organization, but large quantities of their land, air and naval equipment came from the United States. This expenditure, which represents about 8 to 10 % of the national revenue of each country, has not even been sufficient to set up forces equal in numbers to those of the satellite states. Moreover, the time is coming when European countries will be required to get together and themselves provide the equipment for their divisions and squadrons. To reduce their military expenditures at a time when the problem arises of replacing tens of billions of dollars worth of equipment would mean a drastic cut in armed forces, which would be reduced to the level of police forces. The disorganization resulting from any substantial reduction in military expenditure, in Western Europe at least, can be imagined. A completely new situation would arise, in which, as Léo Szilard remarked, "the machine gun would be the only weapon available in quantity." The question is under what regime and under what flag such a position could be envisaged or tolerated in Europe.

*

What would become, under these different plans; of the military organizations set up by each of the two groups of powers to defend themselves against an aggression by the other? What would become of N.A.T.O. and the new Eastern counterpart, the Warsaw alliance? If President Eisenhower's proposition were accepted, it would not modify the basic military problem facing the two sides, at any rate at the beginning. In the long run, as each of the "Biggest Two" became more familiar with the other's military apparatus, the risks run could be more accurately assessed, and new forms of defence evolved. In Europe, N.A.T.O.'s principal task would be to fill the military vacuum—which always invites trouble—and to arrest any development that might degenerate into a localized conflict and later into general war. With the threat of a surprise atomic attack at any rate three quarters removed, and localized conflict rendered impossible, the world could advance quietly to unhurried negotiation and progressive normalization of East-West relations. Mr. Nutting's plan, however, could change everything. If it were applied to the East of a reunified Germany, it would upset the political reasoning behind the Warsaw agreements. If applied to the present Iron Curtain it would mean renunciation of West Germany's military contribution and probably the withdrawal of some of the British and American troops stationed on the continent. In this case, N.A.T.O. would in practice cease to exist in its present form, while the Eastern unified command behind the Iron Curtain would remain. If the Russian proposals for a ban on atomic weapons were adopted, N.A.T.O.'s position would become extremely precarious. Europe would have agreed to renounce a weapon of terrifying effect without being able to balance the adversary's power by means of less devastating weapons. The question would arise as to whether it would not be more intelligent to abolish all forces rather than maintain a useless force. Much the same situation would arise as a result of a massive cut in defence expenditure. But in the latter case the European nations would seek the atomic protection of one of the "Biggest Two". This would mean a system of indirect defence instead of the present collective defence.

The problem of disarmament and total peace will not be solved within the next few years. In fact, the question of armed forces, whether atomic or conventional, is of secondary importance compared with the political, economic and social factors essential to general agreement. Meanwhile, the nations will remain more or less armed and on their guard.

RADAR...

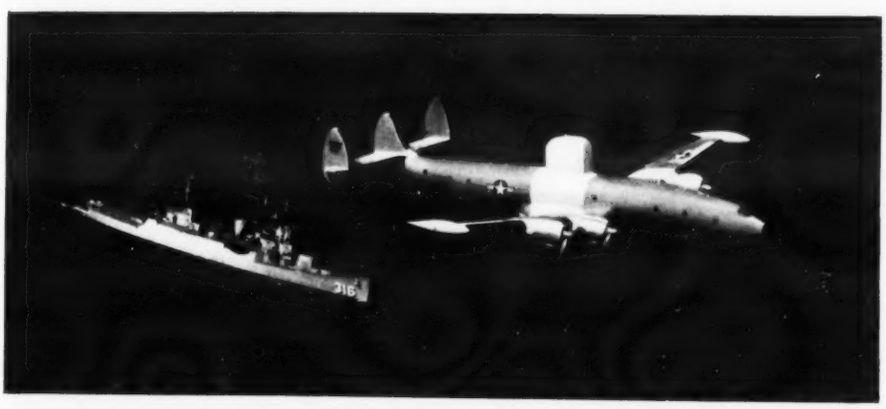


N.A.T.O.'s most northerly radar warning chain, the joint U.S.-Canadian Distant Early Warning line along the edge of the Arctic Ocean, is built of equipment brought in by air. A U.S. Air Force Douglas C-124 *Globemaster* transport landing at a D.E.W. air base equipped with GCA (surveillance plus precision approach radar).

Electronic eyes for air warning and "automatic pursuit"

It is not surprising that the Western Allies should attach such importance to constructing radar warning stations along all present and future demarcation lines between East and West, as outlined in the foregoing article. Old-style optical and acoustical aircraft detection equipment would not even suffice to warn the civil population in the critical areas of impending air attacks, let alone enable active air defence forces to get into action. This applies above all to areas near a potential enemy's "airfield zone": for example, there is barely 600 miles as the crow flies, i. e., one flying hour for a bomber, between the lower Oder and the British capital, while the distance to the Ruhr, being only half as long, could be covered in 30 minutes. On the other hand the Russians can argue that Moscow is only about 900 miles from the mouth of the Oder . . .

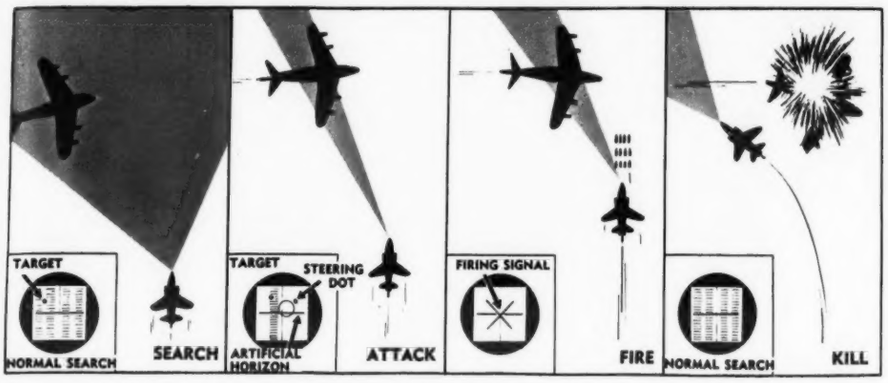
Where the human eye of the air observer is no longer adequate—and at night and in bad weather it is in any case powerless—it is replaced by radar's "electronic eye". As illustrated by Thomson-Houston's civil surveillance radar, it penetrates to a distance of some 180 miles and an altitude of more than 34,000 ft. Long-range radar stations are being built in particular in central Canada and along the Arctic Ocean and supplemented to an increasing extent by artificial radar islands, picket ships and early warning aircraft. If an international agreement were reached to push



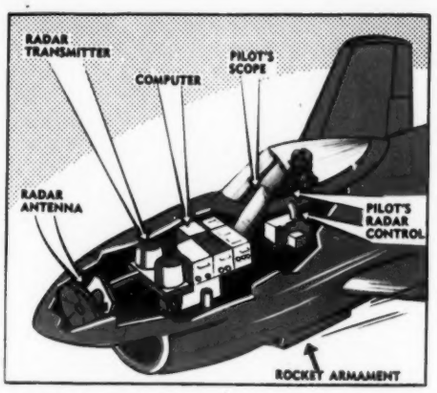
Artificial islands (Texas Towers) off the United States' Atlantic and Pacific coasts, together with shipborne and flying radar stations, help to secure the continent from surprise air raids. The radar picket ship U.S.S. *Harveson* (DER-316) and a Lockheed WV-2 early warning radar aircraft.

This Thomson-Houston long-range surveillance radar, working in the 10-cm band, is used for air traffic control purposes in the Paris-Northern France control region. – Thanks to the 33-ft. aerial reflector group (rotating at 6 r.p.m.) and a peak power of 600 kW, detection range is a good 180 miles and extends to an altitude of more than 34,000 ft.

Radar to assist the anti-aircraft artillery: the control room of the U.S. Army's 518th Anti-Aircraft unit at Fort Barry, California. Reports from the radar stations are entered on the operations board (left). The position board shows the battery sites.

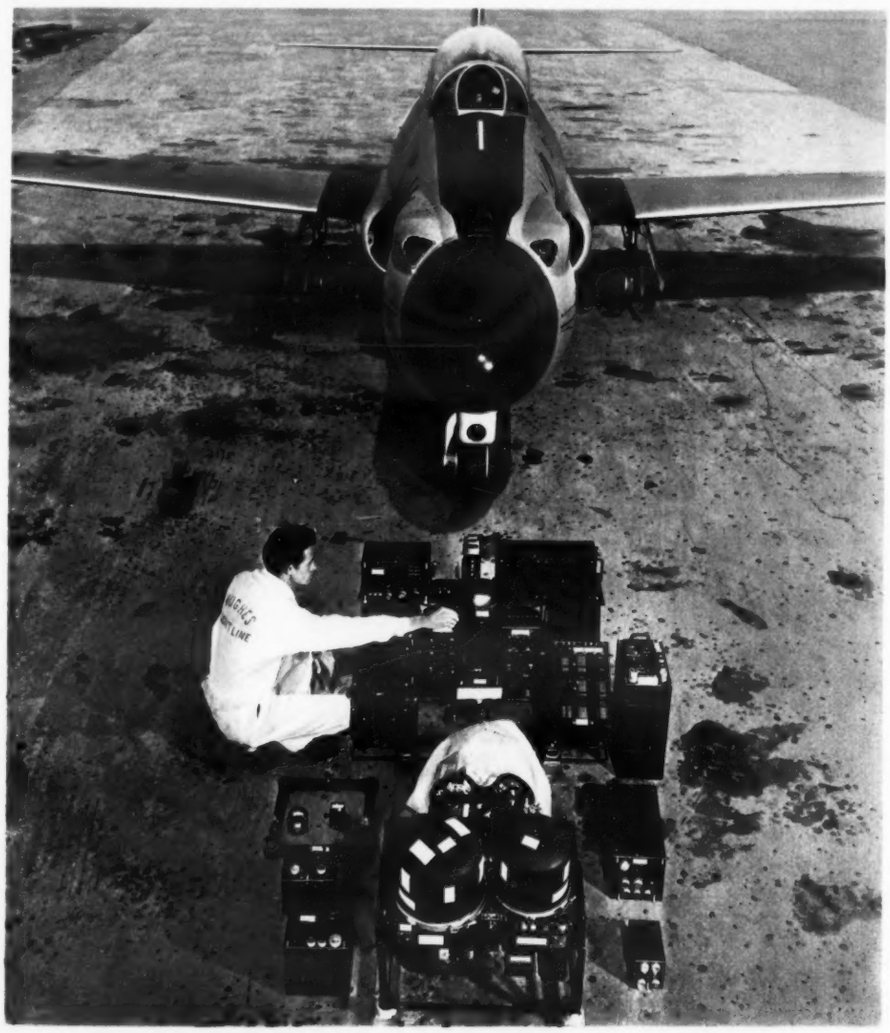


The four main phases in "automatic pursuit" with Hughes Aircraft Co.'s electronic fire control system: during the search phase the pilot of the all-weather fighter patrols the area alloted to him by ground control until he sees the blip of a target on his cathode ray tube. In the attack phase he narrows the scanning angle of his radar beam, keeping the target constantly "in view," and feeds the automatically calculated azimuth and distance values into a computer which delivers steering signals to him by means of the steering dot. All the pilot has to do is to steer his aircraft in such a way that the dot remains in the centre of the reference circle. When distance from the target has been reduced to the required value for opening fire and the target is in the sights, the computer automatically fires the guns or rockets, whereupon an "X" (firing signal) appears on the scope. In the fourth and last phase (KILL) the pilot veers away and switches back to "search", while the target is hit and normally destroyed.



The main elements of a Hughes Aircraft Co. electronic control system for all-weather fighters: aerial group with parabolic reflector (housed in the fuselage nose under a plastic cowling); radar transmitter-receiver (with cylindrical drums); electronic computer; cathode ray tube with pilot's scope and pilot's radar control. Rocket armament is carried under the fuselage and in wing containers.

Hughes "seek-find-and-kill" electronic control system. Front to back: radar transmitter-receiver; cathode ray scope with controls; computer. – The equipment pictured here contains as many parts as 200 civilian television receivers; the aircraft is a Lockheed F-94 *Starfire*.



long-range radar stations forward into Europe's "semi-demilitarized" zones, 100 to 200 miles over the demarcation line, this would give an extra 30 minutes' warning and greatly reduce the surprise effect of a raid, if not eliminate it altogether.

In 30 minutes a substantial defensive force can be mobilized and—again thanks to radar—brought into action with good prospects of success. If warned in sufficient time, the rocket batteries and anti-aircraft guns stationed on the approach routes can be supplied with accurate firing data by radar acquisition equipment and electronic computers, whereupon electronic homing heads (in anti-aircraft rockets) or proximity fuses (in anti-aircraft shells) make destruction of the raider highly prob. le. Similarly, within 30 minutes today's all-weather fighters, which can carry up to 100 rocket projectiles or 20-mm and 30-mm-cannon, can be alerted by the radar ground stations, directed to the threatened sectors and guided to the most favourable attack positions and combat altitudes. "Automatic pursuit", i. e., detection, attack and destruction of the target, would be provided for by airborne radar equipment and electronic computers. The pictures on this page are the first to be released (in addition to the photo in No. 11, p. 638) of the Hughes fire control system now fitted in all continental U. S. and Canadian fighters.

It would be wrong to think, however, that radar is used only for defence. Employed in conjunction with bomb sights or homing heads for long-range missiles, it also forms a directly offensive weapon. Last but not least, it is today the backbone of en route and approach navigation and hence of all aviation, both civil and military.

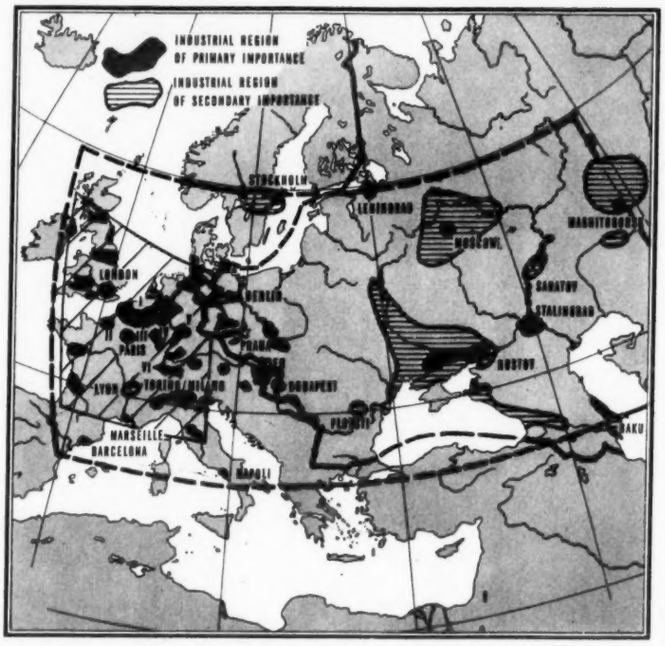
Long-Range Air Transport in an Undivided World

BY INTERAVIA STUDY GROUP

Even before they reached Chicago, the Russian delegates to the 1944 international air transport conference were recalled by their Government. Though they had considered it desirable a few months earlier, by the end of October 1944 the Kremlin leaders had decided against cooperating in the organization of future commercial aviation. Doubtless preparations were already being made even then for erecting the famous Iron Curtain which was to divide the victorious Allies and partition the world by isolating first more than 200 million people and later, with the satellites of West and East, nearly 800 million, who were thus cut off from normal business and cultural exchange.

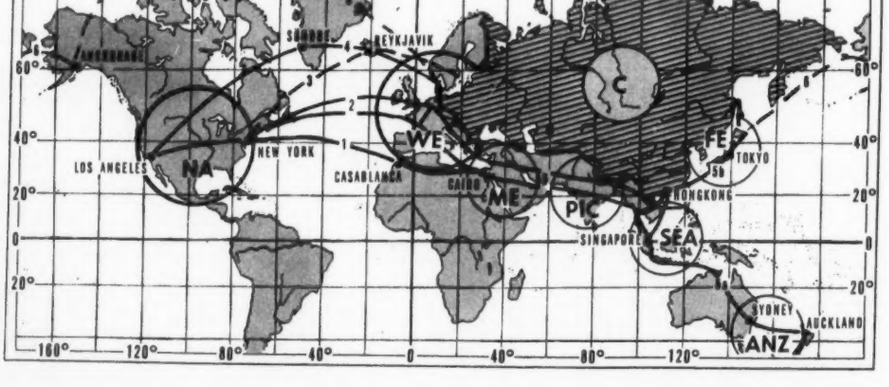
Eleven years later Max Hymans, out-going President of the International Air Transport Association, urged that commercial aviation also be permitted to benefit from the new spirit shown at Geneva last July: . . . "there remains only one barrier, a political one, to free world air transportation . . . this impenetrability is the reason for the long routes between West and East, between Europe and Japan, between America and India . . . this impenetrability . . . betrays the Western principle of free movement of men and goods which led our ancestors to cut through peninsulas and isthmuses." Juan Terry Trippe, new I.A.T.A. President, added that if Russia would apply for Aeroflot's admission to I.A.T.A. this would be a proof that she plans if not to remove the Iron Curtain altogether, at least to draw it slightly aside for the benefit of air travel.

When B.O.A.C.'s annual report was published at the end of August, Sir Miles Thomas stressed the value of the *Britannia 300 LR* should relations between Russia and the Western Powers take a new turn. From London to Tokyo, via Moscow and Mukden or Peking, he pointed out, the route would be about 3,500 miles shorter than the present route via Pakistan and India . . . Russian and Chinese aircraft already operate two services a week between Moscow and Peking . . . All this explains why B.O.A.C. is anxious to have a fleet of British-built long-range air-



Western Europe and "unified Europe" as economic areas: Today the industrial region of Western Europe is limited in the East by the "Iron Curtain." It includes in the Northwest the seven most important industrial centres in Britain and extends in the Southeast to the upper Italian industrial region. At the heart of this quadrilateral (shaded) lie: the Northern French-Belgian-Northwest German industrial region (I), the Le Havre Area (II), Paris (III), Lorraine-Saar (IV), Frankfurt-Mannheim (V), the northern Swiss region (VI) and a half dozen other economic centres. – If an understanding were reached between East and West, and economic barriers were removed, the centre of gravity of European industry, which would then cover the whole area marked by the broken lines, would move much further east. The main axis of European air transport would thus shift from its present north-south direction to an east-west direction.

Diagram of the main air connections North America-Western Europe-Far East in the present "divided" world: The West's two highly industrialized main economic regions, North America (*NA*) and Western Europe (*WE*), are indicated by heavy lines; the areas economically linked with them, around the Communist countries' Eurasian land mass (*C*), are indicated by thin circles: *ME* (Middle East); *PIC* (Pakistan, India, Ceylon); *SEA* (South East Asia); *FE* (Far East); and *ANZ* (Australia-New Zealand). – Map shows the four Great Circle routes used by air transport between North America and Western Europe: *good weather route 1*, from New York via the Azores to Casablanca or Lisbon); *main Atlantic route 2*, via Gander (Newfoundland) and/or Shannon (Eire); *northern route 3*, from New York via Reykjavik (Iceland) and South Norway, e. g., to Stockholm; *Greenland route 4*, from Los Angeles via Winnipeg (Canada) and Söndre-Strömfjord (Greenland) to Copenhagen. – Route 2 connects up in London, Paris or Amsterdam with *southern Asian route 5* which runs via Cairo, Karachi, Calcutta, Bangkok to either *Sydney* (5a) or *Tokyo* (5b). As route *5b* measures no less than 8,250 nautical miles from London to Tokyo, S.A.S. is planning to fly round the other way from 1956 onwards, via Thule (Greenland) and Alaska to Tokyo – *Greenland-Alaska route 6* – on which the distance between Copenhagen and Tokyo is only 6,850 nautical miles.



Note: In the Mercator projection of this map the Great Circle routes (shortest distance between two points on the earth's surface) appear as sinusoidal lines.

Air routes:

1	•	New York-Azores-Casablanca	3,100 nm
2	•	New York-Gander-London	3,000 nm
3	•	New York-Reykjavik-Stockholm	6,300 nm
4	•	Los Angeles-Söndre Strömfjord-Copenhagen	4,850 nm
5a	•	London-Beirut-Karachi-Singapore-Sydney	10,250 nm
5b	•	London-Cairo-Karachi-Bangkok-Tokyo	8,250 nm
6	•	Copenhagen-Thule-Anchorage-Tokyo	6,850 nm

craft. As regards range required, transcontinental flights east of Moscow are at least as long as the east-west trans-Atlantic crossing.

Western airlines are not only sounding the new trumpets of Jericho constructed in Geneva this summer with a view to bringing down the Iron Curtain, but are already making plans for procuring equipment capable of operating on the trans-Asiatic routes which would be opened to them if Moscow abandoned its air transport isolationism and granted the Five Freedoms. Thus Western airline circles are returning to tentative planning somewhat resembling that of the end of World War II.

In September 1944 Pan American World Airways applied to the U.S. Civil Aeronautics Board for authorization to operate a number of intercontinental services, including one from New York via Newfoundland, Ireland, Norway and Sweden to Leningrad. This was also one of the projects included by C.A.B. itself in its programme for post-war expansion. A route from New York to London, Berlin, Prague and Istanbul also figured in this programme. On the Pacific side, North America was to establish an air route network serving China via Alaska, Mukden, Peking and Chung-King in the north, and via Honolulu, Wake, Manilla and Canton in the centre. And in July 1945 P.A.A. resumed its trans-Pacific services from San Francisco to Shanghai, while two months later C.A.B. granted China National Aviation Corporation the right to operate between China and California with an intermediate landing at Honolulu. Shanghai was the sixth largest city in the world as regards population and before the war handled 60 % of the trade between China and the United States. But in 1949 China also closed her territory to the West's commercial aviation.

During the war British and American geo-politicians and air transport experts drafted a world air transport network whose links were distributed evenly over the earth's surface. But the political partition of the world created new conditions. The largest of the continents became inaccessible except for its peninsulas and islands. Western air routes had to avoid the immense Sino-Russian area and follow more tortuous paths.

Europe benefits from the partition of the world

In laying the foundation of his air route policy Parker Van Zandt had divided the world into eight economic regions, among which North America and what he called "Greater Europe" were the most important. "Greater Europe" comprised the whole of Europe except Russia, including the British Isles and the Mediterranean area from North Africa to Turkey in Asia. Between these two regions, which alone accounted for nearly 30 % of the world's population, 40 % of the cultivated land and 64 % of the world's gross income, there was an immense potential for trade exchanges of which air transport would take its share. The European countries, anxious to re-establish as soon as possible the links with the outside world which the war had severed, concentrated their efforts on building up long-range air fleets. But they had been ravaged by war and could not hope to find in their own territory a big enough market to support the expansion of the new air transport industry. In the United States, however, the fact of having conducted hostilities—chiefly in the air—on a global scale had created the taste, the need and the means for air transport operations covering the five continents.

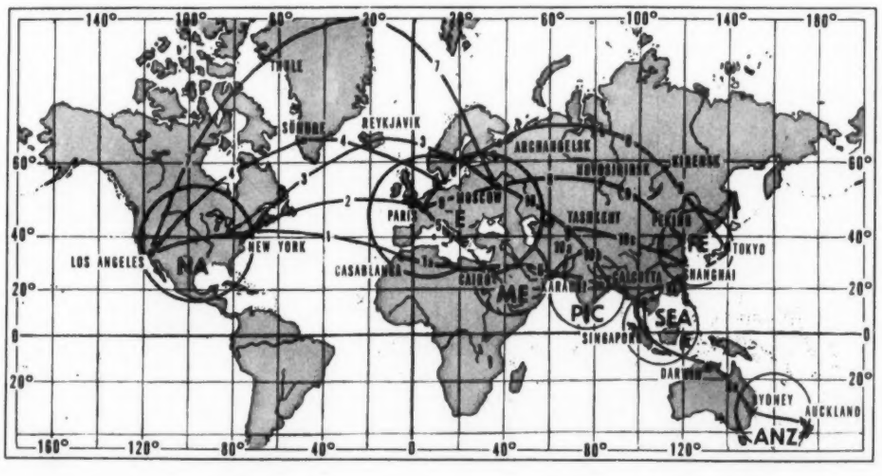
There are three main air routes between these two principal economic regions which the war has made so dependent on one another. The southern route entails a long ocean crossing and terminates in the Mediterranean area. The second is the northern route via the Great Circle passing through Labrador, Iceland and the Norwegian coast to Finland. Stages on this route are shorter, and weather conditions generally good, but it terminates in a region closed to traffic.

There remains the central route via Newfoundland, Ireland and Northern France. This is the shortest route from New York to the centre of Western Europe's most commercially and industrially active region. Both the closing of Russian-controlled territory to air transport and the economic and political situation in West Germany immediately after the war tended to push the politico-economic centre of gravity of convalescent Europe still further west. The air routes were diverted to the western part of the European peninsula, terminating in London and Paris, on the western edge of the quadrilateral of greatest economic activity. Added to this shift westwards there was a move towards the south of Eurasia. Aircraft were obliged to follow the old silk route, at any rate as far as India, giving greater value to the Mediterranean countries, Arabia and the Indian and Burmese peninsulas. After a long detour to the south they reached Manilla and Japan and connected Europe with the Pacific round the periphery of the land mass under Russo-Chinese control.

It is obvious that, at any rate to a certain extent, many of the southern Asian countries owe their air transport development to Soviet isolationism. Similarly this attitude on the part of the Russians has undoubtedly improved the air transport position of countries such as France. French territory has become the normal continental base for services

Diagram of main air connections (excluding South America and Africa) in an "undivided" world: Highly industrialized economic centres are now North America (*NA*) on the one hand and "unified Europe" (*E*) on the other; the Far East (*FE*) would again include China. Other economic centres would be as hitherto: *ME* = Middle East; *PIC* = Pakistan, India, Ceylon; *SEA* = South East Asia; *ANZ* = Australia and New Zealand. *Present Atlantic routes 1 to 4* would be joined by the new *Great Circle route 7*, from Los Angeles via Thule (North Greenland) to Moscow. *Northern route 3* could also be extended to Moscow. On the other hand there would be scarcely any attraction in a Greenland-Alaska route to Tokyo (ex-route 6), as direct services on the Great Circle from Copenhagen (or Paris) via Archangelsk and Kirensk, i. e., the *trans-Siberian Northern route 8*, would be 2,200 nautical miles shorter. Flights to Central Siberia and North China could use *trans-Siberian Southern route 9*, which runs from Paris or Moscow via Novosibirsk to Peking; services to Shanghai, Calcutta and Karachi would be quicker via Moscow and Tashkent, i. e., on the *Pamir routes 10* (a, b, c), than on today's route 5. Apart from local traffic, the latter would therefore be of interest only as a main Commonwealth route (London-Karachi-Calcutta/Colombo-Singapore-Sydney-Auckland). — Here it may be noted that the Russian airline Aeroflot made a first reconnaissance flight on the Moscow-Tashkent-New Delhi route at the end of October 1955.

Note: In the Mercator's projection of this map the Great Circle routes appear as sinusoidal lines.



Air routes:

7	•	Los Angeles-Thule-Moscow	5,350 nm
8	•	Paris-Archangelsk-Kirensk-Tokyo	5,250 nm
9	•	Paris-Moscow-Novosibirsk-Peking	4,400 nm
10a	•	Moscow-Tashkent-Karachi	2,500 nm
10b	•	Moscow-Tashkent-Calcutta	3,000 nm
10c	•	Moscow-Tashkent-Shanghai	4,000 nm

Max Hymans, President of Air France and I.A.T.A. President for 1954-55, urged at the I.A.T.A. General Meeting in New York that air transport take on the Geneva « New Look ».

Juan Terry Trippe, President of Pan American World Airways and I.A.T.A. President for 1955-56, expressed the desire that the Russian Aeroflot should join I.A.T.A.

Sir Miles Thomas, Chairman of British Overseas Airways, discussed in the Corporation's Annual Report for 1954-55 the possibilities of Far East services after removal of the Iron Curtain.

Air Marshal S. F. Zhavoronkov, Director General of Russia's Civil Aviation and head of Aeroflot is also considering the possibility of liberalizing West-East air transport.

connecting America with Asia by the West-East route. Again the Mediterranean countries have also seen the growth of transit services well beyond their local needs. Admittedly, at the time when the general appearance of the post-war world air network was developing, the air fleets available were more suitable for short-stage services between a dozen neighbouring countries than for non-stop trans-Siberian flights covering several thousands of miles.

*

What would happen in the commercial aviation world if the Communist governments emerged from their isolation and joined their air networks to the national and international networks that the free world has developed during recent years?

1. The "detour" via southern Asia and the peninsulas (Arabia, India, Burma, Thailand, Vietnam) would no longer be essential, and several thousand miles could be saved on the air routes between Western Europe on the one hand and China and Japan on the other. The classic route via the Mediterranean and India would lose some of its users, who would take a more direct, shorter route, but it would still retain its value for services between Europe and Australia and of course India.

2. The European terminal point for the northern air route between North America and Europe would be moved further east, roughly along the Great Circle passing through Labrador and the Norwegian coast near Trondhjem. The Arctic route, already in use between California and Scandinavia, would be widened to include Thule and Moscow. Moreover airports in Germany and more generally in Central and Eastern Europe would become the starting points for intercontinental services and would rival London and Paris in the distribution of trans-oceanic traffic.

3. The Mediterranean route, at any rate in the West-East direction, could be abandoned by long-distance services in favour of more northerly routes.

4. Four or five major routes would be open to international traffic: a northern route placing Japan within 12 to 15 hours of London by tomorrow's four-jet commercial transports; a central route from the industrial region of Western Europe via Moscow and Novosibirsk to Peking; and several southern routes connecting India, Indonesia and Australia with Moscow. Finally, C.A.B. would get the America–Asia routes it had planned earlier, via Alaska and Manchuria in the north and the Philippines in the south, to Peking and Canton.

5. The normalization of air transport relations between East and West would obviously eliminate the role of "filter" now played by certain satellite countries. But the conditions created by the change in Europe might well be different from those in Asia. In Europe there are a large number of air transport undertakings that will be striving to make a living and will operate at least continental services even if they are debarred from long-distance operations. In the Far East the demand for air transport is proportionately greater, and local resources smaller. Thus opportunities for non-Communist countries on the periphery may be more certain.

6. But above all a group of peoples with an annual output of 400,000,000 tons of coal, 60,000,000 tons of steel and 250,000,000,000 kilowatts of electric power would join the world markets. The external signs of this power increase regularly by more than 5 % each year. The main power sources of the Soviet *bloc* are still concentrated in the West of Russia's territory, and it is towards this industrial region, i. e., eastwards, that Europe's economic centre of gravity would be shifted.

7. The aspect of air transport inside Western Europe would be radically altered. The general axis of air communications, which today runs northwest to southeast, would shift to a direction parallel to the latitudes and connect up economic zones that are today completely independent of one another. Average stage lengths would be considerably lengthened.

*

Are the political, strategic and economic conditions for such a reorganization in existence? Could the Russo-Chinese airspace be freely opened tomorrow to the Western world's air transport companies? The reply is not in doubt. Political and economic systems on the two sides of the Iron Curtain are still too different for the airspace to be unified so quickly. If Aeroflot operated, on a reciprocal basis, on Western air routes, there would be little obvious benefit to the Soviet Government, in view of the peculiar nature of the Russian "chosen instrument". It is virtually unthinkable that the U.S.S.R. should grant the Five Freedoms to a foreign airline. Competition between such different organizations as foreign airlines and the Russian Government airline in its present form would be virtually out of the question.

Is it then possible, in these conditions, to apply the "Geneva spirit" to the air transport field? The only result for some time to come will probably be a few authorizations to fly over Communist territory. After all, the system of air corridors that exists between West Germany and Berlin could be extended to a number of main commercial arteries through Soviet airspace. But further "Genevas" will be needed before real interpenetration can be achieved. Meanwhile the satellite countries' airlines continue to play their part: they run services to the outside world and form a kind of "filter" between Western and Eastern traffic. Hence the *status quo* may still remain for some time.

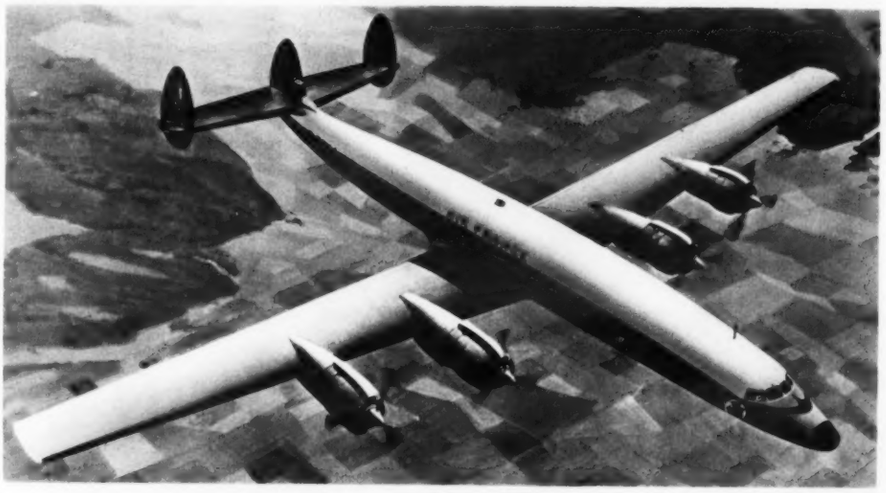
Long-Range Aircraft for Tomorrow's Air Transport

The first of the 102 Douglas DC-7C *Seven Seas* long-range aircraft (compound engines) on order is nearing completion.

If peace still broke out, real peace in an undivided world . . ., the Russian airline Aeroflot would probably immediately order really up-to-date turbine-powered transports in either the United States or Britain. Why should the Russians leave their share of the lucrative long-range air transport business in a world at peace solely to the "capitalists"? If, one day, the main Eurasian air routes move northwards from the so-called peninsula line (Arabia–India–Indo–China) and pass through Moscow, Archangelsk, Novosibirsk and Tashkent, Aeroflot would undoubtedly claim reciprocal rights and cut in on the no less profitable traffic to North America, via either the Atlantic or the Arctic.

A closer study of the maps in the preceding article reveals that the standard stage lengths on world air transport's main routes are at present roughly 2,500 miles, but will soon increase to 3,500 miles or more. For example, the distance between London and Gander is roughly 2,440 miles, New York and Los Angeles 2,500 miles, Los Angeles and Honolulu (longest Pacific stage) 2,550 miles. The new "lower standard value" of 3,500 miles would correspond roughly to the Great Circle distance between London and New York, Los Angeles and Thule (or Söndre) or Anchorage and Tokyo, while a direct flight from New York to Frankfurt or Copenhagen would involve a stage length of approximately 3,900 miles. However, the main routes in the Atlantic hemisphere can be covered in shorter hops, as Gander (Newfoundland) is only

Drawing of the new Lockheed L-1649A *Super Constellation* (with compound engines), of which 36 have so far been ordered.



Aircraft Type	Power Plant	Take-off Power	Span	Length	Wing Area	Max. Gross Weight	Max. Payload	Wing Loading	Power loading	Max. cruise speed	Max. range	Mean cruise altitude	Passengers	First flight	First deliveries
Boeing 707	4 × P & W JT3 (J-57)	4 × 11,000 + lbs	140′ 0″	134′ 6″	—	230,000 + lbs	30,000 lbs	—	5.2 lbs/lb.t	550 + mph	appr. 4,500 miles	42,000 + ft.	104—125	—	Dec. 1958
Douglas DC-7C *Seven Seas*	4 × Wright R-3350-EA.1	4 × 3,400 HP	127′ 6″	112′ 3″	1,637 sq. ft.	140,000 lbs	21,000 + lbs	85.5 lbs/sq.ft.	10.3 lbs/HP	360 mph	appr. 6,000 miles	28,000 ft.	58—62 +	End of 1955	Summer 1956
Douglas DC-8	4 × P & W JT3 or JT4 (J-57 or J-75)	4 × 11,000 + lbs or 4 × appr. 15,000 lbs	134′ 6″	140′ 6″	2,594 sq. ft.	257,000 lbs	32,000 lbs	99.0 lbs/sq. ft.	5.9 lbs/lb.t or 4.3 lbs/lb.t	575 mph	4,000 + miles	40,000 + ft.	108—131	End of 1957	End of 1959
Lockheed L-1049G *Super Const.*	4 × Wright R-3350-DA.3	4 × 3,250 HP	123′ 5″	116′ 2″	1,650 sq. ft.	137,500 lbs	appr. 24,000 lbs	83.3 lbs/sq. ft.	10.6 lbs/HP	334 mph	5,580 miles	22,600 ft.	59/63—94	—	Early 1955
Lockheed L-1649A *Super Const.*	4 × Wright R-3350-EA.2	4 × 3,400 HP	150′ 0″	116′ 2″	1,850 sq. ft.	156,000 lbs	20,000 + lbs	84.3 lbs/sq. ft.	11.5 lbs/HP	350 mph	7,000 miles	22,600 ft.	58/62—93	1956	Spring 1957
Bristol 175 *Britannia 300LR*	4 × Bristol *Proteus* 755	4 × 4,120 HP	142′ 3″	124′ 3″	2,075 sq. ft.	165,000 lbs	28,000 lbs	79.5 lbs/sq. ft.	10.0 lbs/HP	415 mph	appr. 6,200 miles	appr. 30,000 ft.	up to 101	1956	1956/57
Lockheed *Electra*	4 × Allison 501-D.13	4 × 3,750 HP	99′ 0″	104′ 2″	1,300 sq. ft.	110,000 lbs	20,600 lbs	84.6 lbs/sq. ft.	7.3 lbs/HP	410 mph	appr. 3,000 miles	appr. 30,000 ft.	66—91	—	August 1958
De Havilland *Comet* 4	4 × Rolls-Royce *Avon RA.29*	4 × 10,500 lbs	105′ 0″	102′ 0″	—	152,500 lbs	16,850 lbs	—	3.6 lbs/lb.t	appr. 500 mph	2,850 + miles	42,000 + ft.	58—78 +	—	1958
Vickers V.900 *Vanguard*	4 × Rolls-Royce RB.109 *Tyne*	4 × 4,470 HP	appr. 118′	appr. 118′	—	100,000 + lbs	21,000 lbs	—	5.6 lbs/HP	400 + mph	*up to 2,500 miles	30,000 ft.	85/93—105	1958	1959/60
SNCASE SE.210 *Caravelle*	2 × Rolls-Royce *Avon RA.26*	2 × 10,000 lbs later 2 × 11,000 lbs	112′ 6″	103′ 4″	1,589 sq. ft.	90,400 lbs	21,000 lbs	57 lbs/sq. ft.	4.5 lbs/lb.t	490 mph	*2,400 miles	appr. 42,000 ft.	70—91	May 1955	—

* With greatly reduced payload

Bristol *Britannia 100* turboprop transport, forerunner of the *Britannia 300 LR.*

Douglas DC-8 long-range jet transport.

Boeing 707 long-range jet transport.

Designed for "long" medium stages: Lockheed *Electra* turboprop t ansport (top) and prototype *(Comet 3)* of de Havilland's new pure jet aircraft.

1,975 miles from Shannon (Eire), Copenhagen about 2,150 miles from Söndre. The "trans-Siberian northern route" from Western Europe via Archangelsk to Tokyo could be operated comfortably in three stages, with block distances of less than 2,200 miles.

Commercial transports for block distances of more than 2,200 miles with normal payload are today being built or developed only in the United States and Britain, while the Eastern *bloc* contents itself on the whole with twin-engined medium-stage aircraft. Among recent long-range aircraft greatest interest is aroused by the six types designed to cross the North Atlantic non-stop. They are listed in the top portion of the table: three of these types (Douglas DC-7C, Lockheed L-1049G and L-1649A) are fitted with compound engines, one with propeller turbines (Bristol *Britannia*) and two (Boeing 707 and Douglas DC-8) are pure-jet long-range models.

To supplement this fleet the West have several other fast jet or turboprop aircraft available, that can be described as equipment for "*long*" medium stages (lower portion of table). These include in particular the Lockheed *Electra* and de Havilland *Comet 4,* which will be flying on the longer North American and European continental stages and on the British Commonwealth routes from 1958 or 1959/60 onwards. To complete the picture, data are also given of the Vickers *Vanguard* and S.N.C.A.S.E. *Caravelle,* though both types are offered by their makers as aircraft for *short* medium stages (300 to 1,200 miles).

Once again, therefore, the airlines are facing a complete renewal of their fleets. As all major airlines must make their arrangements at practically the same time, it is not surprising that airline bosses are queuing up in the manufacturers' sales offices and—as soon as they return home—holding lively conferences with their financial backers.

The events of recent months in this direction are without example. First Pan American World Airways ordered no fewer than 45 long-range jet transports (25 Douglas DC-8s and 20 Boeing 707s) to a total value of $269,000,000, closely followed by United Air Lines who contracted for thirty DC-8s ($175,000,000) and American Airlines (30 Boeings for $135,000,000). Further orders have been placed by National Airlines (six DC-8s) and K.L.M. (eight DC-8s). Among newer piston-engine types 102 Douglas DC-7Cs have so far been ordered by some dozen airlines and—by 20 companies—193 Lockheed L-1049 *Super Constellations* (most of them are already in service) and 36 L-1649A *Super Constellations.* Firm orders for the Bristol *Britannia* have been received from British Overseas Airways Corporation (33 aircraft), Canadian Pacific Airlines (3 aircraft) and El Al Israel Airlines (3 aircraft). Finally, American Airlines and Eastern Air Lines have ordered 75 Lockheed *Electras* between them (total value $165,000,000), and B.O.A.C. has contracted for 19 de Havilland *Comet 4s.*—In other words, investment in long-range aircraft already runs into billions of dollars. On the other hand billions of dollars are also earned in long-range air transport.

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Aircraft:

FIAT G 82	
FIAT G 91	
FIAT F-86K	(North American Aviation licence)
FIAT VAMPIRE	(de Havilland licence)
FIAT VENOM	(de Havilland licence; parts)
NORTH AMERICAN F-86D SABRE	(overhauls for U. S. A. F. E.)

Jet engines:

FIAT GHOST 48 Mk 1	(de Havilland licence)
ALLISON J-35-A-29	(Allison licence; parts)
GENERAL ELECTRIC J-47	(General Electric licence; parts and overhauls)
CURTISS-WRIGHT SAPPHIRE J-65	(parts for U. S. A. F. E.)
D.H. GOBLIN	(de Havilland licence)

Piston engines:

PRATT & WHITNEY R-985	(Pratt & Whitney licence; parts and overhauls)
PRATT & WHITNEY R-1830	(overhauls)
PRATT & WHITNEY R-2800	(overhauls)
ROLLS-ROYCE MERLIN 500	(overhauls)

Propellers:

FIAT 5006 two-blade	(Hamilton licence)
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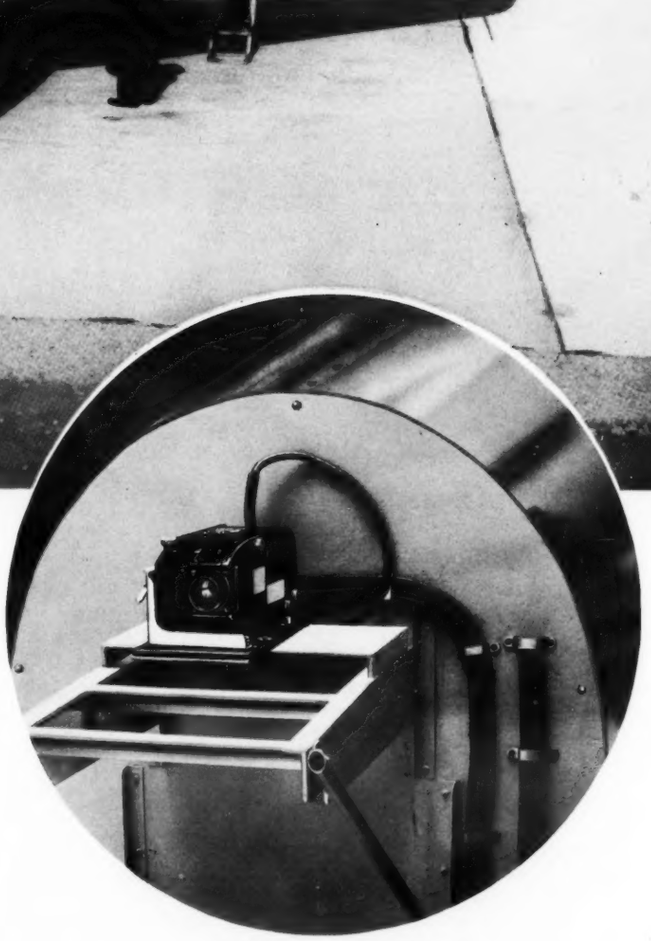
CELEBRATING 10 YEARS OF JETPOWERED AERONAUTICAL DEVELOPMENT IN CANADA

SEASON'S GREETINGS

Photo by courtesy of Hawker Aircraft Co. Ltd.



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Red Air Force transports, as also used by Aeroflot, at Geneva's Cointrin Airport. Left a Li-2 (copy of DC-3); right an Ilyushin Il-14 refuelling.

Eastern European Air Transport before the Camera

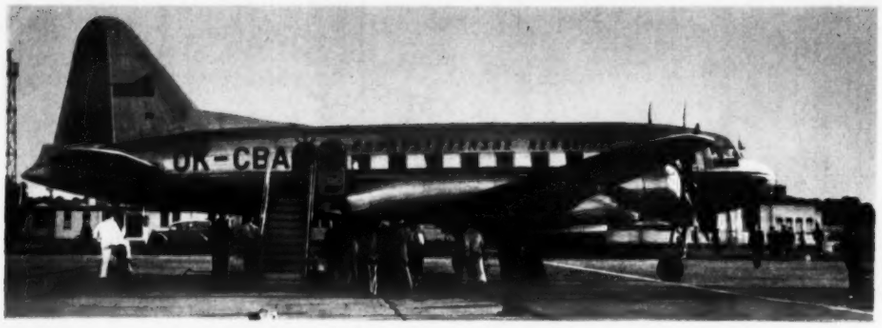
At the Geneva Foreign Ministers Conference the United States, Britain and France urge that the barriers between West and East air transport be removed. The I.A.T.A. General Meeting in New York urges the Russian airline Aeroflot to apply for membership in the International Air Transport Association. In Old and New Worlds airlines urge their governments to open air transport negotiations with the U.S.S.R. It almost looks recently as if all air transport roads lead to Moscow. In some respects, however, the proposals for closer cooperation between West and East air transport resemble an equation with several unknowns.

P.A.A., B.E.A., Air France . . ., the Western airlines are well-known to all. Nobody, however, has any real idea about Eastern air transport, and when it comes to exact figures and data even "Jane's", the best-informed yearbook on world aviation, gets into difficulties. Admittedly it gives a survey of the types used by Russia's Aeroflot, but can do no better than "more than 400 aircraft" as indication of fleet size. Even this is of little use, since the Soviet Union's civil and military transport fleets are admitted to be an indivisible whole . . . under the Red Army General Staff.

Thus anyone not wishing to waste his time in fruitless speculation must be content with brief "visiting cards" for the Eastern European airlines, which give little more than name and head office of the company. Occasionally these bare details are supplemented by snapshots from photo reporters. The following are small samples of these two sources of information.

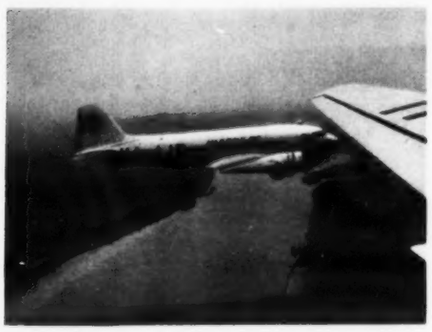
● 1 – *Aeroflot, the U.S.S.R.'s State airline,* with headquarters at the Hotel Metropole, Sverdlov Square, Moscow. Aeroflot holds—or held until recently—50 % of the capital of most Eastern European airlines. Its aircraft, which are also used by all Eastern airlines, are twin-engined medium-stage types: Il-14, Il-12, Li-2, Yak-16, Shcherbakov E-2. According to a report published in "Literaturnaia Gazeta" for September 1955, Aeroflot's route network increased from 100,000 miles in 1948 to 108,500 miles in 1954. The longest and busiest route is Moscow–Vladivostok–Sakhalin (5,090 miles as far as Vladivostok, with intermediate landings).—In October 1955 the head of Russia's travel agency Intourist announced that Aeroflot was offering Western tourists a fare reduction of 50 % (with 600 miles free rail travel on combined air and rail journeys).—On the recent report that Aeroflot is to operate jet aircraft (modified Il-28 twin-jet bombers)

The heads of the Soviet Government arrived in Geneva for the "Big Four" conference in July in up-to-date Il-14s. Left and right, Il-14 (with the red star of the Russian Air Force); centre, Il-12 (with Aeroflot markings and red flag).



The Czech C.S.A. airline operates primarily Ilyushin Il-12s, in addition to Douglas DC-3s . . .

. . . While the East German Deutsche Lufthansa is already being equipped with the more up-to-date Il-14.



An Li-2 of the Hungarian MALEV airline over Budapest

EASTERN EUROPEAN COMMERCIAL AND MILITARY TRANSPORTS

Aircraft	Li-2	Ilyushin Il-12	Ilyushin Il-14	Ilyushin Il-20 (Il-28)	Tupolev TU-70
Power plant	2 M-62-R	2 Shvetsov ASch-82 FNW	2 Shvetsov ASch-82 T	2 RD-45	4 M-90
Take-off power	2×1,000 H.P.	2×1,850 H.P.	2×2,600 H.P.	2×5,730 lbs.	4×2,500 H.P.
Span	94′ 8″	104′ 0″	104′ 0″	appr. 72′	141′ 5″
Length	64′ 5″	69′ 11″	69′ 11″	appr. 65′	99′ 5″
Wing area	987 sq. ft.	—	—	—	—
Max. take-off weight	26,000 lbs.	38,000 lbs.	appr. 36,400 lbs.	appr. 45,000 lbs.	132,000 to 143,000 lbs.
Max. payload	appr. 6,600 lbs.	6,600 + lbs.	appr. 6,600 lbs.	appr. 6,600 lbs.	—
Wing loading	26.4 lbs./sq. ft.	—	—	—	—
Power loading	13.0 lbs./H.P.	10.3 lbs./H.P.	7.0 lbs./H.P.	3.9 lbs./lb. t.	—
Max. cruise speed	appr. 170 m.p.h.	200 m.p.h.	—	500 + m.p.h.	appr. 280 m.p.h.
Max. range	appr. 1,500 miles	up to 1,850 miles	—	—	—
Max. altitude	appr. 20,000 ft.	20,000 + ft.	—	—	—
No. of passengers	15 to 21	21 to 32	18	—	—

for mail on the Moscow–Peking route: no comment.

• 2 – *Ceskoslovenske Aerolinie (C.S.A.)*, Namesti Republiky, Prague. Equipment: Il-12, Douglas DC-3.—C.S.A., a member of I.A.T.A. and of I.A.T.A.'s Clearing House in London, operates to several European capitals (Vienna, Berlin, Warsaw, Copenhagen, Stockholm, Helsinki) and has for some months been running a Prague–Paris service in pool with Air France (each airline three times a week), with connections to Aeroflot's services to Moscow.—United Press correspondent Daniel F. Gilmore, who travels regularly in Eastern Europe, states that C.S.A.'s operations and comfort come closer to Western standards than those of other Eastern airlines (. . . "sandwiches, Pilsen beer etc.").

• 3 – *Polski Linie Lotnicze*, Hoza 39, Warsaw. I.A.T.A. member. Flying equipment: DC-3, Li-2, Il-12, Il-14, Aero 45. Traffic figures for 1954: revenue miles flown 2,380,000; passengers 135,359; passenger-miles 32,214,400. Operates to Prague, Budapest, Bucharest, Sofia, Vienna, Berlin, Brussels and Paris and was the first non-Russian airline authorized to run scheduled services to Moscow, early in 1955.

• 4 – *MASZOVLET* (Magyar-Szovjet Legiforgalmi Reszveny Tarsasag), the Hungarian airline. Originally the Hungarian Government and Aeroflot each contributed 50 % of the capital, but Aeroflot relinquished its share to Hungary at the end of 1954. Name now MALEV, address 7 Dorotya utca, Budapest. With ten Li-2s operates mainly cargo services to Eastern European capitals.

• 5 – The *Rumanian TARS* (Transporturi Aeriene Romano-Sovietica) was also half Russian, half Rumanian owned. New name TAROM, address 11 Strada Nicolai Jorga, Bucharest.—Fleet Li-2s, Il-12s.

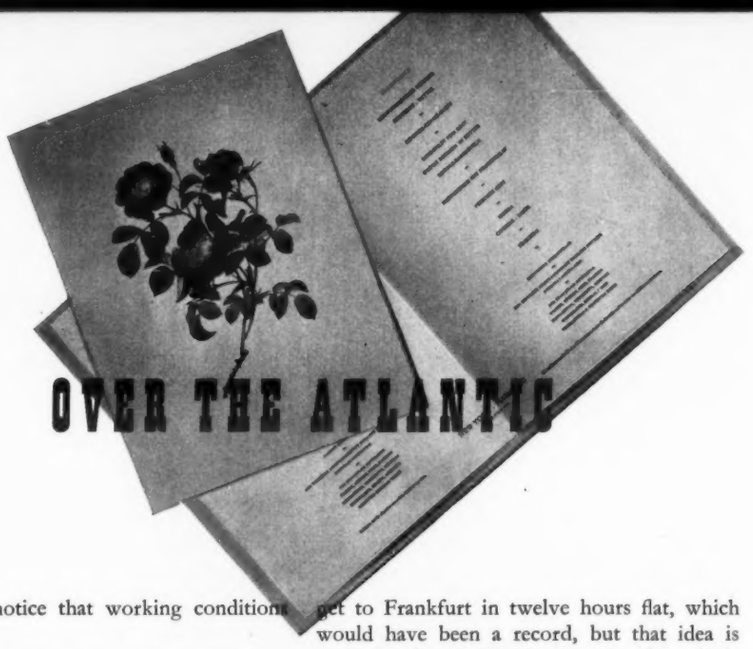
• 6 – The *Bulgarian TABSO*, 12 Naradno Sobranie, Sofia. Capital: 50 % Bulgarian Government, 50 % Aeroflot.—Fleet Il-12s, Li-2s. Operates to Budapest, Prague and Berlin.

• 7 – The East German *Deutsche Lufthansa*, latest addition to the Eastern European airlines, is still in development. An agreement between the East German Democratic Republic and the U.S.S.R., signed in Moscow on October 18th, 1955, provides for Russian technical assistance and advice. Other air transport agreements have been concluded with all the Eastern European countries listed here. Home base, Berlin-Schönefeld (and Leipzig-Mockau).—Fleet at present only Il-14s. For the time being charter services only are operated, to train crews for scheduled operations.

October 18th, 1955: Lieutenant General N. A. Sakharov (Aeroflot) and Arthur Pieck (East German Lufthansa) signing the agreement in Moscow on technical and commercial cooperation in air transport.

Crew of the East German Lufthansa's first aircraft.

DEUTSCHE LUFTHANSA



OVER THE ATLANTIC

Fifth Avenue, New York: — Every airline worth its salt has its main city office along this artery of New York life or on one of the side streets adjoining it. *Deutsche Lufthansa,* which was resurrected in May 1955, is no exception. On the twelfth floor at 555 Fifth Avenue—the rent comes high!—Lufthansa's New York office staff of about sixty works busily in relatively small offices. On the main floor in the side street a large show window permits you to look into the ticket office decorated in blue-and-yellow, Lufthansa's colours. A pleasant office, but none too big. For several months now the company's operations in the U.S.A. have been under the management of *Wolfgang Kittel,* an air transport veteran. Kittel won his spurs years ago with S.C.A.D.T.A., the Colombian line formed after World War I by Germans and Austrians, which today is known as Avianca and was the first airline that made a profit without resorting to subsidies. Its relations with the old Lufthansa were very close, and Kittel knows his business. Now he is building up the company's organization in the United States. Compared with what other European airlines—not to mention the Americans—are doing, this seems to be a heroic undertaking, for he is working on a very tight budget.

A day later we drive out to Idlewild, New York's International Airport. Needless to say, all the big airlines have their long ticket and baggage counters. In one corner the small counter of the new Lufthansa is located and behind it is a tiny, crowded office. The traveller is bound to notice that working conditions are not ideal.

We are "checked in" in no time. The staff are polite, efficient, and their familiarity with foreign languages is exemplary. Just outside we find the Lockheed L-1049 *Super Constellation* Type G, which differs from other members of the *Constellation* family by its wing tip tanks to enable it to cross the North Atlantic non-stop whenever possible.

We taxi to the runway, the pilot runs up his engines, takes off. First he planned to fly non-stop from New York to Frankfurt, backed by tail winds. Shortly after take-off today's inevitable cocktails are wheeled through the cabin on a trolley. An excellent luncheon—supplied by Swissair for the time being—follows, served by young ladies whose excellent manners are pleasant and whose appearance, furthermore, is more than pleasing to behold. A nap after lunch seems indicated, and we awake just as the cocktail trolley starts on its round again to herald dinner. "Sleeperettes", a term registered as a trade mark by Pan American Airways, are also available aboard Lufthansa's *Constellation,* the pillows are the same as everywhere, the blankets large and especially good quality.

As the passengers wake up again they are faced by a small surprise: the original plan to fly non-stop has been dropped. The wind has changed, an intermediate landing is necessary. Shannon is closed, the captain mentions London Airport. He had hoped to get to Frankfurt in twelve hours flat, which would have been a record, but that idea is now abandoned. The longer trip places little hardship on the passengers—but is less agreeable for the crew. In addition it costs the company money for fuel, ground handling, servicing and refreshments during the stop. As the aircraft approaches Europe and passengers eat their dinner the captain informs us that conditions have improved at Shannon and that we shall land there. It is about four o'clock in the morning, Central European time. A light breakfast at Shannon, we are scheduled to go out again in an hour. However, the weather upsets our plans once more. Thick fog descends upon the Irish airport, lifts, comes back in a matter of minutes. One hour becomes nearly four, several trans-Atlantic airliners stand waiting on the tarmac until the sun comes through. The fog disperses and we take off again. It is now around eight in the morning, in about three-and-a-half hours we are to arrive at Frankfurt. Another miscalculation, for several other aircraft—mostly American military transports, for Frankfurt is used jointly by the airlines and the U.S. Air Force—are ahead of us and we have to stack. For nearly an hour we circle above Frankfurt, then we dive through the cloud and land gently on German soil. We are cleared smoothly by immigration service, customs and police, Lufthansa delivers our baggage in record time compared with other airlines and other airports.

To sum up: a flight aboard the L-1049 G *Super Constellation* of Lufthansa is basically no different from a trip with any other big airline. Cabin service is remarkably good, polite, unobtrusive. Food is excellent. The crew is numerous: nine men in the cockpit—for the American skipper and his American navigator also teach the new German crews—and three cabin service personnel.

Lufthansa's Lockheed L-1049 G *Super Constellation* ready for take-off, equipped with wing-tip tanks for non-stop Atlantic crossings.

*

Lufthansa Heardquarters, Cologne. On Claudius-Strasse there is a building which would remind any German of his school years. It is in fact a building, spared by wartime bombing,

The *Super Connie's* co-pilot and flight engineer are Germans.

Bon appetit!

Coffee, rolls and butter from the Lufthansa aircraft galley, designed and built by the firm of Sell.

Cocktails are rolled through the cabin on a trolley.

belonging to Cologne University which has offered its hospitality to Lufthansa. To term the atmosphere austere would be an understatement—it is Spartan. Executive and staff offices are former classrooms or professors' quarters. They have made the best of the resources available to them.

Lufthansa's two top executives are *Hans M. Bongers,* Commercial Director, and *Dipl. Ing. Gerhard Höltje,* Technical Director. The former graduated from the school of Lufthansa's old Directors, Milch, Wronsky, von Gablenz, and Luz; Gerhard Höltje, too, belonged to the junior engineering staff of the old Lufthansa. Reporting directly to top management are *Wolfgang Kittel,* General Manager for the U.S.A., as mentioned above; *von Brauchitsch,* Assistant to the Management, who is responsible for interline agreements; and *H. G. von Studtnitz,* Public Relations Officer, a post which today has become inevitable on any airline staff roster.

The *organization diagram* on this page explains the rest. In Lufthansa's set-up the concentration of major tasks in the hands of only two top executives is remarkable and differs considerably from the system employed by other large and medium airlines: Bongers and Höltje share the general management, with Commercial Director Bongers acting as a sort of Managing Director, while Höltje looks after Engineering, Maintenance, Equipment, Operations, Personnel Training, etc.

In Cologne again one has the feeling that everybody is hard at work. Cologne is the brain of Lufthansa—and about 250 miles away is the heart of the organization, the engineering workshops, the maintenance centre in Hamburg.

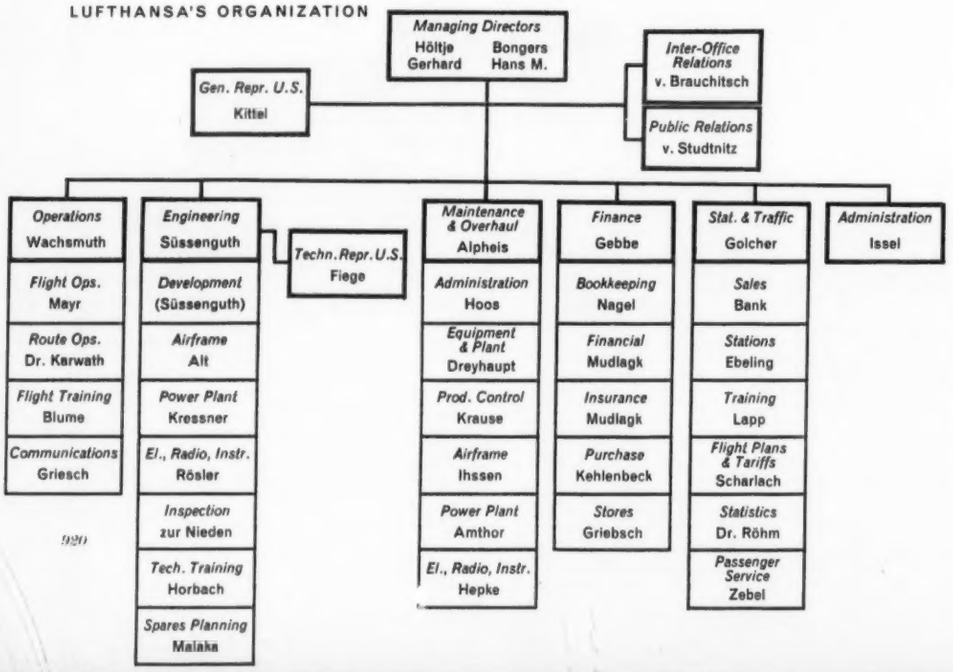
*

Hamburg Maintenance Centre. — The Public Relations Officer, a former journalist of worldwide experience, is a pleasant companion His staff is supplemented in Hamburg by a charming young lady bearing the English-sounding name of *Mrs. Christina T. Cripps* who is said to be indirectly related to the late Sir Stafford. In any case, she is a credit to the name.

Lufthansa's top management (left to right): Technical Director Dipl. Ing. Gerhard Höltje, Chairman of the Board Dr. Kurt Weigelt, Commercial Director Hans M. Bongers.

Next morning, we drive out to Lufthansa's installations. While Cologne was Spartan, to say the least, things look different in Hamburg, which does not mean that the place is full of unnecessary frills. But the new office buildings, the vast maintenance halls, the engine and equipment overhaul shops, the engine test house indicate that Hamburg did not pinch its pennies in its efforts to secure Lufthansa's custom (. . . until the day when it moves to Berlin after all). Of about 1,950 Lufthansa employees about 1,350 are at Hamburg, the remainder are scattered among Cologne headquarters, the offices in the U.S.A., in Germany and other European countries. Again we refer to the diagram, which shows who does what. Head of the Hamburg Maintenance Centre is *Dipl. Ing. Joachim Alpheis,* and in the Operations Division veteran Lufthansa *Captain Walter Blume* is charged with the task of training the new personnel. His task is not an easy one, for the personnel problem is one of the two bottlenecks still hampering Lufthansa's operations—the second will be dealt with later.

LUFTHANSA'S ORGANIZATION



At the moment the following aircrew are in service with the company: eleven captains from British European Airways and eleven from Trans World Airlines flying the European and overseas routes, respectively. On paper there exists a group of 135 German pilots, of whom 52 already fly as co-pilots while 83 are still in training. Forty-seven flight engineers are also being trained as radio operators; 24 of these are on flying status, the other 23 are in training. Thirteen radio operators/flight engineers are in service, as well as nine American navigators for the long-distance routes. This is the nucleus. It should suffice for the eight *Super Constellations,* the last four of which are scheduled for delivery in 1956, four Convair 340s and two Douglas DC-3s. A strength of 216 aircrew sounds fine, but it must be remembered that many of them are still in training. But if the company expands—and it is scheduled

One of Lufthansa's four Convair 340's at Paris-Orly Airport.

Engine test house at Lufthansa's Hamburg maintenance base.

to grow—Lufthansa will be forced to hire additional foreign personnel in the next few years until such time as a new German Commercial Flying School—yet to be created—can train new German aircrew.

*

A fateful question. Much has been said and read about the new German Lufthansa. When its resurrection became a tangible probability there were many who were afraid of the new competition it would provide. Others, mainly in Germany, again believed in a new German miracle. So far all of them have been wrong. In its present shape Lufthansa has not been a serious competitor to any foreign airline, and to many a German it has so far been a disappointment. For Lufthansa's present network of routes is by no means world-wide, and this in spite of certain agreements which German Government officials have concluded with European and overseas countries and about which also *Interavia* reported somewhat more optimistically than now seems to have been justified. It sounds wonderful to say that one has operating rights for routes from New York to the Caribbean area and on to South America. Yet, actual operations do not depend upon Bonn and Washington alone but also on Rio de Janeiro, Buenos Aires and numerous other capitals. This is just one example.

Lufthansa's leaders have planned the company's expansion on a long-term basis—ten years or so. These plans may work, provided they are not implemented too late. For the management is handicapped by two bottlenecks, one of which—the personnel problem—has just been mentioned, whereas the second should be dealt with in somewhat greater detail.

When the writer of these lines was in the United States a few weeks ago, this question was put to him as a European: *Does Lufthansa intend to become a major air carrier again?* The answer could have been simply, naturally! The real crux of the problem, however, can be outlined as follows: under what conditions can Lufthansa become a powerful airline, and can it reach its goal within a useful period of time?

This brings us to the second bottleneck, the *nervus rerum*—money. Lufthansa suffers from lack of capital, and it suffers from the fact that it is the young post-war child of a young administration.

Let us take a look at the structure of other airlines. American companies have grown up on a private-enterprise basis, their stock is held privately and is traded on the Stock Exchange. When they are in need of funds, they go to the money market, they raise their capital or, on the basis of their financial soundness, they obtain loans from banks and insurance companies.

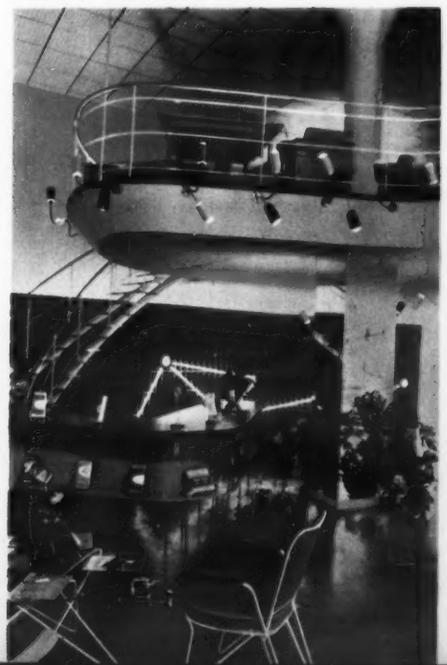
Most of the European airlines are State-owned. In the immediate post-war years some of them received a precious *à fonds perdu* gift in the form of large air fleets under the Marshall Plan. In addition the State generally helps them with open or concealed subsidies and makes good—things like this can happen—any deficits they may incur.

A small number of European companies operates on a composite State-and-private-enterprise basis, inasmuch as the State holds a minority share of the stock, whereas the majority is held by banks, insurance companies and individual stockholders in order to ensure that private initiative is maintained. Such a system permits the airlines to resort to the private finance market if required. In the past few years this has been necessary with increasing frequency, for aircraft types have changed more rapidly, must be modernized more quickly and become more costly all the time.

So far as Lufthansa is concerned, the company is an offspring of the Federal Ministry of Transport which built it up within the limits of its ability and to suit its own tastes. Also,

Lufthansa's Hamburg maintenance base.

Lufthansa's Hamburg city office.



Wolfgang Kittel, Lufthansa's General Manager for the U.S.A.

Chief Pilot Walter Blume.

Chief Air Hostess Ursula Tautz.

Dipl. Ing. Joachim Alpheis, head of the Hamburg maintenance base.

H. G. von Studtnitz, Public Relations officer.

it took good care that on its Board of Directors officialdom has the final word. While the Chairman of the Board, *Dr. Kurt Weigelt,* is a private businessman, he was elected only because he was the last Chairman of the old Lufthansa and because he was backed at the time at least by the prestige of the all-powerful Deutsche Bank. Today he no longer is backed by this prestige. Weigelt's Deputy is Vice-Chairman *Dr. Kurt Knipfer,* Director of a Ministry Section in Bonn, who represents the Minister of Transport. Also on the Board are the Mayors of Cologne and Stuttgart, the Chairman of the Federal Railways, *Professor Dr. Frohne*—whose first love must be the railways—as well as a representative of the Federal Ministry of Finance, *Dr. Oeftering.* Under-Secretary of State *Dr. Leo Brandt* represents North Rhine-Westphalia; he is an experienced transportation expert but does not always seem able to assert himself. The Board is completed by another gentleman from the Ministry of Transport, four employee representatives and . . . alone in this wilderness, a delegate from the Norddeutsche Lloyd as the sole representative of private enterprise, industry and trade. This illustrates the manner in which the Board is composed of official brass. If Federal Finance Minister *Dr. Schäffer* decides to loosen his purse-strings, then Lufthansa could become a very large State-owned corporation. So far he has opened his purse only very reluctantly, and in view of the multitude of money demands he must face every hour his reluctance is comprehensible.

Lufthansa now endeavours to make better use of the private money market by granting private investors a kind of preferential treatment when it decides to issue new stock. However, it is an old rule that private capital is slow to participate in an enterprise which is

Hans M. Bongers directs Lufthansa's economic activities.

dominated by the State. Private investors would want to know what is happening to their money and, above all, would like to have a voice in determining the use to which it is put. Thus, if the Board Members listed above were to resign in favour of private investors' representatives, no obstacle would theoretically be left in the path of private enterprise. But this will remain a theory for the time being.

The post-war Lufthansa differs from its other European post-war sisters also in the fact—emphasized above—that the Marshall Plan placed no gifts in its cradle. Since for this post-war child everything must be paid for in cash, Lufthansa cannot operate without substantial deficits in the years of build-up and expansion. Who is to cover these deficits? If the Federal Government could muster the generosity to make good these losses for a period of, say, five years or so; if the Government took the point of view that the German flag airline's share in air transport should correspond to the 6 percent share which Germany contributes to world trade, then everything would be well with Lufthansa. In that case private enterprise, accepting a Government minority interest, could calculate its chances, i. e., a modest annual return on its investment, and climb aboard the Lufthansa wagon. It could be imagined that as a company of composite financial structure with a Board consisting of men widely known in world business and finance, Lufthansa could again become one of the leading airlines within two or three years. German heavy industry, chemical industry, shipping, banks and insurance companies would no doubt all be ready to play their parts. But with due respect to their patriotic sentiments they would nevertheless be hard-headed businessmen and would not forget the profit motive. In any case they have no desire to play second fiddle to Government officials.

How Lufthansa will ultimately solve its problem is an open question at the moment and the cause of considerable anxiety for its management. At present its investment resources amount to approximately DM 136,000,000. For an emergency programme it requires DM 250,000,000, and in order to reach a state of equality with its major sister companies it would probably need funds of the order of about DM 500,000,000 in the foreseeable future. This would roughly correspond to the net worth of companies such as K.L.M.-Royal Dutch Airlines or Air France—to say nothing of U.S. airlines.

Initially the company would make do with eight four-engined and four twin-engined transports. For a rudimentary expansion of the overseas routes twelve four-engined aircraft are an absolute minimum. To neglect intra-European operations completely because they are not very lucrative would be a mistake, for the other European airlines would simply "book away" Lufthansa's potential overseas passengers, because these passengers would never get as far as Lufthansa's ticket office.

And now that every airline that can scrape the money together will have to decide in principle and in fact to fly the Atlantic with jet transports in about seven hours from 1960 onwards, Lufthansa in its present state is confronted with the fateful question: can it again become a major airline, can it reach such a goal within a useful period of time, and how? *EEH*

The Hamburg aircraft maintenance hall.

I.A.T.A. in New York

CAB Chairman Ross Rizley welcomes I.A.T.A. Delegates on behalf of U.S. Government. At left (half concealed) Sir William Hildred, I.A.T.A. Director-General; at right, M. Max Hymans, outgoing I.A.T.A. President. Front row, members of I.A.T.A. Executive Committee, including (left to right) Air India International's Tata, TWA's Warren Pierson, Sabena's Périer, LAI's Prince Pacelli, Avianca's Gregorio Obregón, SAS' Per Norlin, TCA's Gordon McGregor, BOAC's Major Ronald McCrindle.

This year it was different. The Eleventh Annual General Meeting of the International Air Transport Association, which was held in New York from October 17th to 21st, 1955, differed from earlier meetings not only because it took place at the "highest level", namely, the eighteenth floor of the Waldorf Astoria Hotel, or because it celebrated the tenth anniversary of the resurrected I.A.T.A.

Two major developments in the history of air transport were responsible for the changed atmosphere at I.A.T.A.'s "Tenth Anniversary General Meeting." One was the sudden promise of practical jet-propelled air travel for the foreseeable future. The second was the unanimous determination of all delegates to seek an understanding with the countries behind the "Iron Curtain" which would enable Western and Eastern airlines to fly to points in each other's territories.

The Age of Jet Transport

The advent of the jet transport had actually been heralded a few days prior to the opening of the I.A.T.A. meeting by Pan American Airways' not unexpected announcement of October 13th that it had awarded contracts to Douglas and Boeing for 25 Douglas DC-8 and 20 Boeing 707 four-jet transports. Yet, when the meeting convened on October 17th, the delegates were still visibly impressed. The two contracts underlined the fact that the U.S.A. has definitely won the jet transport race, a fact which was acknowledged by the British a few days later in the announcement that the Vickers V.1000 jet transport project had been dropped. Meanwhile, a fascinating competition has begun to shape up between the two major American jetliner protagonists, Douglas and Boeing.

Concurrently another competition has developed in the medium-range field. American Airlines has bought 35 Lockheed *Electra* turbo-prop (Lockheed calls them "propjet") transports and Eastern Air Lines has ordered 40 *Electras* with an option for 30 more. The British answer to the *Electra* is the Vickers 900 *Vanguard* and the French have entered the fray with the SE.210 *Caravelle* twin-jet medium-range transport.

The Geneva Spirit

When the I.A.T.A. meeting opened on October 17th, the delegates had no indication of whether or not the "Geneva Spirit" would still be in evidence after the "Big Four" Foreign Ministers' meeting which meanwhile has just come to an end without any spectacular results. But to a man they called upon I.A.T.A. to make efforts to pierce the Iron Curtain by air.

Max Hymans, Chairman of Air France and retiring I.A.T.A. President, expressed his sentiments at the Opening Session of the Meeting:

"... The Geneva Spirit must be borne out by facts. We must hope that the wish expressed two years ago by Dr. Berchtold (President of Swissair.—Ed.) as our President—for 'voluntary cooperation, good will and mutual understanding on a world-wide basis'—will become a reality which will be equally apparent on the map ..." (cf. *Air Transport in an Undivided World,* elsewhere in this issue).

Hymans was backed at the same session by Juan T. Trippe, President of Pan American World Airways, and 1955-56 President of I.A.T.A., who quoted from President Eisenhower's report on last July's Big Four meeting in Geneva. "... Particularly we talked about peaceful trade," Eisenhower had said. "But the subject that took most of our attention in this regard was the possibility of increased visits by the citizens of one country into the territory of another, doing this in such a way as to give each the fullest possible opportunity to learn about the people of the other nation."

And Trippe added: "Of course, international airlines are the instruments best equipped to implement this 'Spirit of Geneva'. Although the Czechoslovakian and Polish airlines have long been members of I.A.T.A., *Aeroflot, the Soviet national airline, should also be sitting with us at the I.A.T.A. conference table.*"

The subject was raised once more at the formal banquet on the evening of the opening day by Vice President Richard Nixon of the U.S.A. who emphasized that President Eisenhower's "aerial inspection" proposal of Geneva was perfectly feasible and could be supplemented by ground inspection teams, and who added:

"... I can assure you that in every effort you make toward increased freedom of move-

1 U.S. Vice-President Richard Nixon attended the formal opening banquet at the Waldorf Astoria Hotel. Here he is (centre) with (left to right) Sir William Hildred, Air France's Max Hymans and PAA's Juan Trippe, I.A.T.A. President for 1955-56. **2** Former I.A.T.A. Presidents all: Swissair's Walter Berchtold, TWA's Warren Pierson, TCA's Gordon McGregor, Sabena's Gilbert Périer. **3** I.A.T.A. Delegates and their wives take a boat trip around the Port of New York. At left is Curtiss-Wright Vice-President Irwin. **4** I.A.T.A.'s President Elect, BEA Chairman Lord Douglas of Kirtleside, surrounded by pulchritude. At left is Lady Douglas. The name of the lady at right the Editors failed, alas! to catch. **5** Delegates of Japan Air Lines at work.

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Major U.S. aircraft and engine companies gave a dinner-dance at the Hotel Plaza for the delegates to the I.A.T.A. Meeting. At left is the chorus line, whose dancers are scantily disguised as air hostesses. At right, dancing is in progress. In foreground Raymond Dupré, Air France Vice-President and Technical Director explains a point to Monsieur de Boursac, head of I.A.T.A.'s Paris office.

The Technical Committee Report

"We of the Technical Committee have been unanimous in agreeing that the present state of development of the ground aids essential for a rational operation of our fleet lags behind the corresponding state of development of the fleets themselves by at least five years.

"When I say 'rational operation', I mean the maintenance of exceptionally high safety standards, which it is impossible to compromise on, even if our operations are financially penalized.

"The investments already made or to be made in the near future in new aircraft by all the I.A.T.A. member airlines is of the order of several billion dollars . . . It is obvious that these investments should lead to a reduction in the cost of the passenger seat kilometre . . . Now, it is only on exceptional occasions that we find in the world all the necessary ground facilities for a completely satisfactory operation. As a consequence, we have to suffer every year many unfortunate penalties, such as frequent diversions to extremely distant alternates and the carriage of excessive quantities of fuel which quite naturally reduces the payload. We are often required to operate at undesirable altitudes and to suffer the limitation of many obsolete regulations resulting in unnecessary expenditure."

These are the words with which *Raymond Dupré*, Vice-President and Operations Director of Air France and Chairman of I.A.T.A.'s Technical Committee, for last year, introduced his Committee's report to the 11th Annual General Meeting in New York. He appealed to airline bosses to press their governments, with the aid of incontrovertible figures, for immediate improvements. Finally he announced that *André Priester*, Vice-President of Pan American World Airways, had been appointed new Chairman of the Technical Committee.—The following is a summary of the most important points in the report.

Ground organization: "The need to carry excessive fuel loads, delays in departure, slow handling due to inadequate terminal facilities, inefficient routing or assignment to uneconomic altitudes due to inflexible air traffic control, excessive flight time resulting from inadequate and delayed meteorological information and inefficient communications—all these are problems which we are forced to live with today. Even now we are far from achieving maximum efficiency with our present aircraft."—The total cost of an hour's non-productive flying by a modern aircraft is $ 1,000, so that it is not difficult to estimate the inefficiency throughout the industry: It amounts to many millions of dollars a year.

Approach and landing: The development of electronic aids and modern coupling devices has now advanced so far that any further immediate benefit can come only from improvements in visual aids (for the last 15 seconds before touch-down). The "urgent and pre-eminent need is to see what can be done to improve threshold and runway lighting".—On the other hand, aircraft manufacturers must also do their part towards improving landing safety; that is, they must keep approach and landing speeds down and improve controllability and stability at low speeds. —The Committee expressed its disappointment at the lack of progress on FIDO (fog dispersal lighting). Experiments carried out so far did not permit of any worthwhile assessment of the system.

IFR and VFR criteria: The criteria which determine whether a pilot should fly under visual flight rules or under instrument conditions must be revised. Present criteria were established many years ago, in the days when "all aeroplanes flew at speeds of less than 200 m.p.h." With today's speeds they do not always provide sufficient safety margin for pilots to see another aircraft and take avoiding action.—"The ultimate solution can only lie in the full control of all air traffic at all times," the Committee said. Meanwhile I.A.T.A. recommends that the visibility and distance from cloud criteria determining which set of rules should be used for a given flight should be enlarged so as to give a pilot flying an aircraft at 300 m.p.h. a theoretical period of half a minute to see other aircraft on converging courses and to take avoiding action. In practice this means that the present minimum distance from cloud, either above or below the aircraft, should be increased by 100 %, from 500 to 1,000 ft.

Meteorology: Present procedures for supplying weather data to aircraft in flight must be improved in view of the introduction of very long range aircraft. Before long, block distances of 5,000 to 6,000 miles will become commonplace. On the North Atlantic, therefore, many aircraft will overfly Gander, Prestwick and Shannon.

Air-to-ground communications: In air-to-ground communications I.A.T.A. is attempting to attain universal standardization of radio-telephony procedures in all regions and a clearer understanding of relative responsibilities. The preferred communications medium is today the spoken word, and there are now very few areas in the I.A.T.A. members' worldwide route network in which it is not possible for an aircraft commander to be in voice communication with the ground at all times. The Morse key of radio telegraphy will soon become a museum curio. The report particularly refers to the advantages of the new selective calling system (SELCAL; cf. *Interavia* No. 8, 1955, p. 600).

Navigation aids: To counteract the slowing down that has taken place in many countries in the installation of new VOR ground stations, as a result of the TACAN/VOR controversy (cf. *Interavia*, No. 6, 1955, pp. 449 etc.), I.A.T.A. reiterates its belief that VOR stations will remain in service for another 10 to 20 years. It therefore urges governments to fulfil the I.C.A.O. Regional Plans for VOR networks as early as possible.—In long distance navigation airlines are showing much interest in the new system of Inertial Navigation, which is entirely independent of the ground and hence self-contained in the aircraft (apparently using accelerometers and integrators—Editors). Discussion of this system has not been possible until recently, because of military security rules, but it is now being watched closely by the airlines.

Miscellaneous: The Committee expresses the hope that I.C.A.O.'s next Air Navigation Conference (in 1956) will extend to maintenance personnel the "approved organization" concept of licensing which now applies to overhaul activities. It also recommends that governments should "approve an airline's maintenance and overhaul facilities as a unit, on the basis of the airline's having satisfied the regulatory authority of the competency of its supervisory staff and specialists to act as a team in maintaining its aircraft in airworthy condition".

As for the problem of aircraft noise, I.A.T.A. recommends the formulation of "alieviating operating techniques", with the source of the noise being kept as far away as possible from potential complaints. These techniques include steep take-offs and approaches, preferential runway systems and so on.

The helicopter is expected to become increasingly widely used. I.A.T.A. Helicopter Meetings during the past year had therefore worked out international agreements in principle on a number of basic points.

Finally, the report stresses the urgent need for early execution of I.C.A.O.'s air navigation plans for the North Atlantic: in 1954 no fewer than 60,000 Atlantic crossings were made by scheduled and non-scheduled airlines and military aircraft; by 1959 this figure is expected to rise to 90,000 a year.

ment between countries you have the prayerful and hopeful support of the American people."

On the last day, October 21st, Lord Douglas of Kirtleside, Chairman of British European Airways, was elected President of I.A.T.A. for 1956-57. Of significance may have been the fact that it was announced at the same time that Lord Douglas would shortly go to Moscow for air transport talks—not, it is true, in his I.A.T.A. capacity but as a member of an official British delegation. He arrived in the Russian capital in the second week of November, but so far no details of the British talks have been revealed. However, shortly after his arrival it was stated that B.O.A.C. wanted to fly to Tokyo via Moscow, and from Prague came reports that the Czech CSA was planning to operate an air service to London.

*

These were the highlights of I.A.T.A. Tenth Anniversary Meeting. The rest was more or less routine—review of the past year's work, examination of the results achieved by the various expert committees (Financial Committee, Legal Committee, Traffic Conferences, Executive Committee, Technical Committee), election of officers for the coming year, and the usual social functions. So far as the latter were concerned, the twelve U.S. host airlines kept the delegates from the 75 member air carriers from forty countries and their wives busy from Monday to Friday, with banquets, cocktail parties, theatre shows, excursions, and visits to the United Nations buildings. And the major firms of the U.S. aircraft industry organized an outside dinner-dance, complete with a twenty-violin band, a chorus line and a dixie-land trumpeter, for its customers—the airlines of the world.

Sightseeing around the United Nations Building in New York are Swissair President Dr. Berchtold and Mrs. Berchtold.

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Y-VERTICAL DISTANCE FROM SURFACE

Improving Lift by Boundary Layer Control

At the Society of Automotive Engineers' Golden Anniversary Aeronautic Meeting in New York earlier this year, John S. Attinello, head of the Supersonic Section of the U.S. Navy Bureau of Aeronautics' Research Division, read a paper on the problems of boundary layer control[1]). At first glance it may seem strange that a supersonic aerodynamicist should concern himself with such problems. Nevertheless boundary layer control presents an excellent method of improving the low-speed performance of high-speed aircraft.—The following is a résumé of Attinello's paper, which describes in detail the various methods of influencing the boundary layer.

In view of the fact that the stalling speed of a fixed-wing aircraft becomes higher with increasing wing loading, the question arises of whether the constant increase in take-off and landing speed (and in runway length required) could not be halted by increasing the wing area[2]. Closer investigation, however, shows that aircraft size and weight will spiral rapidly upwards, and in addition to compromising the remaining design requirements, the low speed performance may very well be impaired rather than improved. Since wing area increase results in large performance penalties, the obvious parameter to consider in an attempt to influence the low speed performance will therefore be limited to the wing lift cœfficient.

The mechanism of lift for an airfoil or wing is intimately connected with the behaviour of the thin layer of fluid (air) which is in the immediate vicinity of the solid boundary. This relatively slow moving layer is called the boundary layer and is of importance since its behaviour catalytically influences the flow field about the airfoil.—Considering the flow over a flat plate (fig. 1), the boundary layer is characterized by an orderly flow of distinct layers of fluid. The local velocities in this layer are zero at the body surface, and through the shear forces developed by the fluid viscosity, there is a gradual increase in local velocity at each point measured vertically away from the surface until the free stream velocity is reached. Because of the deceleration of the thin layer of fluid near the solid boundary, the boundary layer thickens progressively along the surface. A point is reached when the disturbances in the boundary layer are amplified, rather than damped, and a so-called transition area develops. In this area (erroneously called point of transition) the laminar flow is altered. Following the transition area, considerable small scale turbulence or interlayer mixing occurs within the boundary layer. This is the turbulent boundary layer and is characterized by a large increase in boundary layer thickness and an altered velocity gradient. For the airfoil surface, the boundary layer must traverse along a surface designed to produce a distinct pressure gradient. At the leading edge of the airfoil, this pressure gradient is first favourable, i. e., the pressure changes from the highest at the stagnation point to lower pressures some distance along the chord, depending upon its design. The boundary layer is then required to move through a region of adverse pressure gradient, i. e., from the low pressure area to the high pressure at the trailing edge. Unfortunately, the boundary layer has difficulty in negotiating the adverse pressure gradient and usually separates from the airfoil surface when some critical Reynolds number is reached. For the flapped airfoil, deflections greater than 20 degrees preclude attached flow over the flap. It is apparent that such flow separation over the upper surface of the wing is accompanied by a loss in lift and eventual stall.

The lift actually obtainable from a practical airfoil falls far short of that theoretically possible because of the behaviour of the boundary layer. Since the formulation of the boundary layer theory by Prandtl some 50 years ago, aerodynamicists have searched for means of effectively influencing the behaviour of the boundary layer so that theoretical lifts could be realized and drag could be reduced. This phase of aerodynamics is appropriately called boundary layer control.

*

To ensure clearer understanding of what follows, the various methods of controlling the boundary layer will first be described: 1–suction of the decelerated layer into the inside of the aircraft; 2–acceleration of the layer by blowing fresh air over the rear portion of the wing; 3–combination of these two methods. All three processes are illustrated in Fig. 2. Method 1 increases circulation around the wing (source of lift) to a slight extent only. Method 2 improves circulation much more, and for this reason is also known as "super circulation". This method also increases the

[1] John S. Attinello: "Wing Lift Augmentation Methods for the Improvement of the Low-Speed Performance of High-Speed Aircraft."

[2] Stalling speed is directly proportional to the square root of the wing loading and inversely proportional to the square root of the max. lift coefficient. – Although max. lift coefficient has been considerably increased during recent decades through the use of high-efficiency landing flaps and leading edge slots, aircraft wing loadings have increased disproportionately, in commercial transports, for example, from roughly 25 lbs/sq. in. (DC-3) to 85 lbs./sq. in. (DC-7C)

Fig. 1: Velocity profile of flow over a flat plate: at first the boundary layer remains attached and laminar, i. e., in parallel layers (A). Surface friction slows it down, however, and it becomes thicker and passes over into the turbulent state (B and (C). The original V-shaped velocity profile finally becomes S-shaped (with backward flow at the end of the plate), and the flow separates from the surface (D).

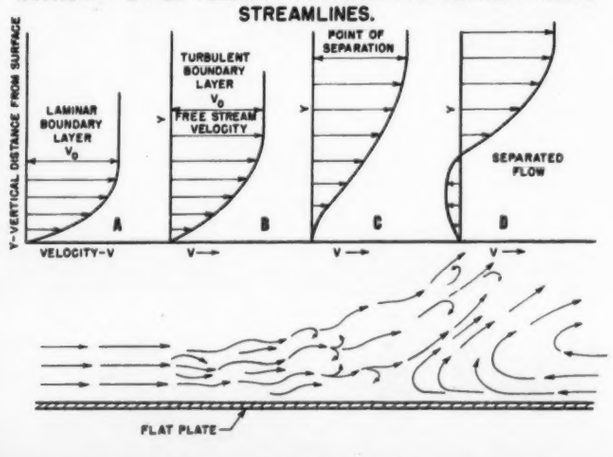
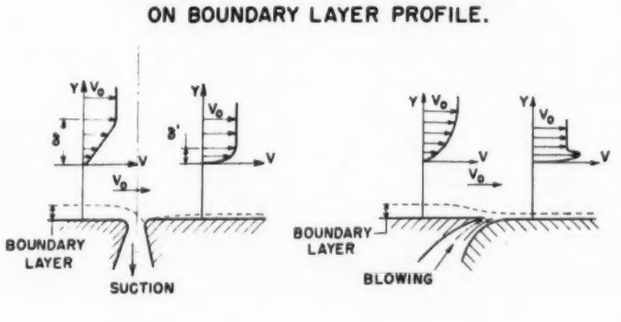


Fig. 2: Influence of suction (left) and blowing (right) on the velocity profile of the boundary layer. The suction slot acts merely as a sink and affects circulation only slightly, as shown by the small increase in velocity in the boundary layer. The blowing slot accelerates the boundary layer much more markedly, and near the surface, even to above the free flow velocity, so that circulation substantially increases and a thrust effect in the direction of flight is obtained.



effective chord of the wing flaps when deflected (Fig. 8) and finally produces a thrust effect in the direction of flight.

Back in the thirties the experiments of the Göttingen Boundary Layer Control Group under Professor Prandtl achieved noteworthy results. This group included such outstanding men as Betz, Schrenk, Schlichting, Schweir, Regenscheit and others. The two outstanding attempts to apply a form of boundary layer control for high lift by this group were the AF-1 and AF-2 versions of the Fieseler Fi 156 *Storch*, with which maximum lift coefficients of 3.5 and 3.8 (compared with 2 in the unmodified Fi 156) were obtained. The suction slots in mid-fuselage (Fig. 4) were connected to the main power plant (Argus As 10 of 240 h.p.) by means of shafting, and a duct leading from the wing to the fan sucked the air off the wing and exhausted it overboard at the sides of the fuselage. Unfortunately, in addition to the weight, space and complexity of the installation, adverse lateral control characteristics were encountered at the low speeds obtained, and the AF installations could not be considered practical.

In America, in 1944, Stalker with the Dow Chemical Co. under an Army Air Force contract attempted to apply suction slots to a full span multi-hinged flap (Fig. 11). Again, the installation complexities and weight left much to be desired, but before engineering improvements could be realized the aircraft crashed, killing the pilot.—Recent research conducted by N.A.C.A. in replacing the slot type of suction by porous material has proved of considerable interest in producing the theoretical increments due to flap deflection up to 40 degrees (experiments with a F-86 *Sabre* with porous flap installation and suction pump under the fuselage). Unfortunately, experience in both America and in England with the porous materials used has indicated that they are very readily clogged by the usual contaminants found in air, and the effectiveness of porous suction rapidly deteriorates. Further research with porous metals may solve this practical problem.

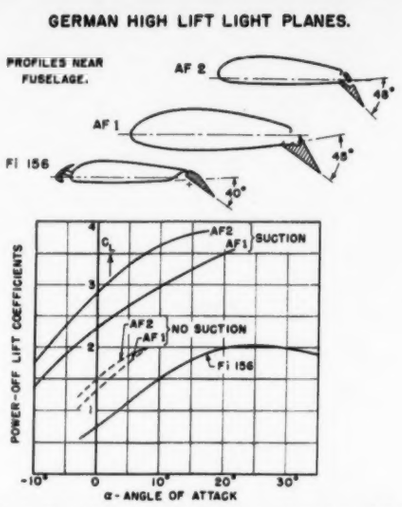


Fig. 3: The AF-1 and AF-2 experimental versions of the well-known Fieseler Fi 156 *Storch* low-speed aircraft differ mainly in their airfoils and the shape of their suction slots. Diagram shows the lift coefficients of the basic type and the two experimental models, plotted against angle of attack. Compared with the normal value of 2 in the Fi 156, the AF-2 version had a max. lift coefficient of 3.8.

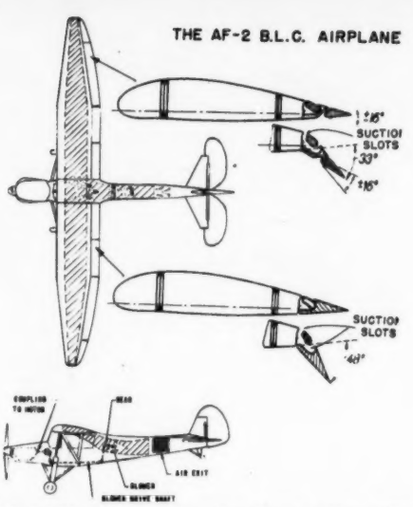


Fig. 4: Diagram of the boundary layer suction system in the Fi 156 AF-2: the suction blowers mounted in mid-fuselage were driven via long shafts from the main power plant. Air was sucked in immediately in front of the flaps and passed out through the sides of the fuselage into the open. The suction slots were placed near the flap hinges, i.e., in the region where the flow most readily breaks away when the flaps are deflected.

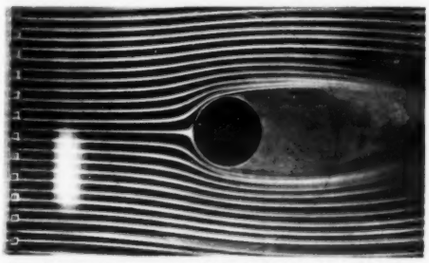
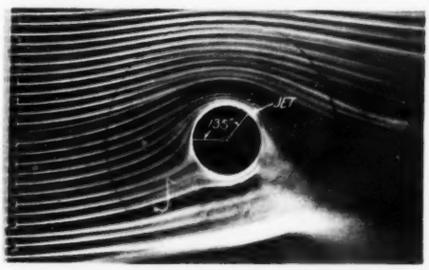


Fig. 5: Smoke-tunnel photograph of flow about a cylinder: below the critical Reynolds number the flow separates roughly at the cylinder's maximum section, so that an extensive wake arises behind the cylinder.

Fig. 6: By blowing a tangential air jet out of the cylinder the flow behaviour is radically altered. Although the jet is situated well behind the normal separation point (at an arc of 135° from the stagnation point of the undisturbed flow), flow remains attached to practically the whole cylinder. The distortion of the flow field and the downward shift of the stagnation point indicate increased circulation.



The second method—a blowing jet directed tangentially to the surface—was also first investigated in the thirties, in particular by Bamber (U.S.A.), Toussaint (France), Baumann, Von Ehlers, Regenscheit and Schweir (Germany). Its first practical application was made during the war in a Messerschmitt Me 109 with two blowers in the wings, driven by the power plant (presumably a 1,500 h.p. DB 605—Ed.). This method also formed an essential element in the combined boundary layer control system as under method 3, which was tried out in an Arado Ar 232 four-engined troop transport and planned for inclusion in the production model of the Ar 234 four-jet bomber. In this system the boundary layer was sucked in near the landing flaps, then accelerated in a blower and finally blown out again near the ailerons. The combined system reduced the amount of air pumped to approximately half that of an all-suction or an all-blowing system. More important, this arrange-

Fig. 7: Flow behaviour about a high-speed airfoil at large angle of attack (smoke tunnel photo). Leading edge and trailing edge flaps are fully deflected, the flow is only slightly curved and forms a large wake of separated flow behind the wing.

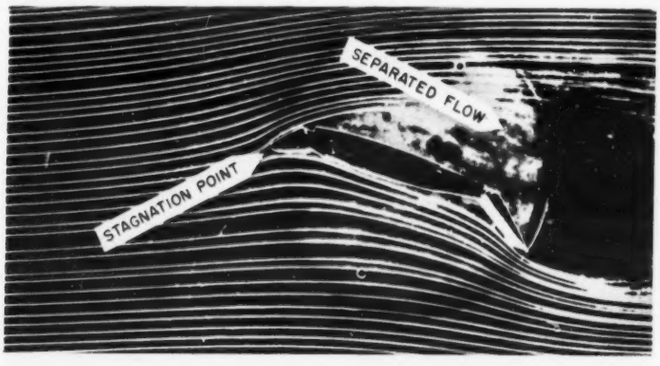
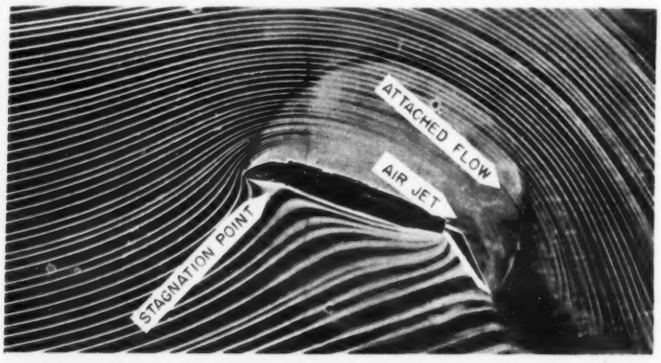


Fig. 8: Flow behaviour round the same airfoil with blowing air jet: the downward shift in the stagnation point and the attached flow over the whole airfoil are evidence of the super circulation produced. The increase in the "effective flap chord" is also discernible.



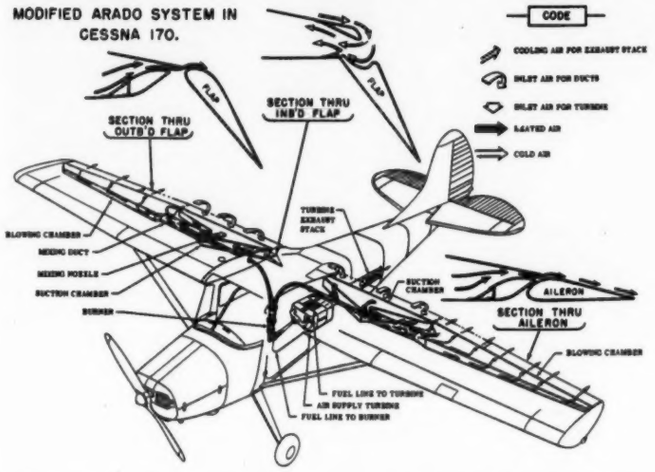


Fig. 9: The U.S. Navy's Office of Naval Research and Bureau of Aeronautics tested the Arado system of boundary layer control in a modified Cessna 170 light aircraft. The original hydrogen peroxide pump was replaced by a burner with air supply turbine, whose hot gases were used to drive the two mixing nozzles fitted in right and left wing halves.

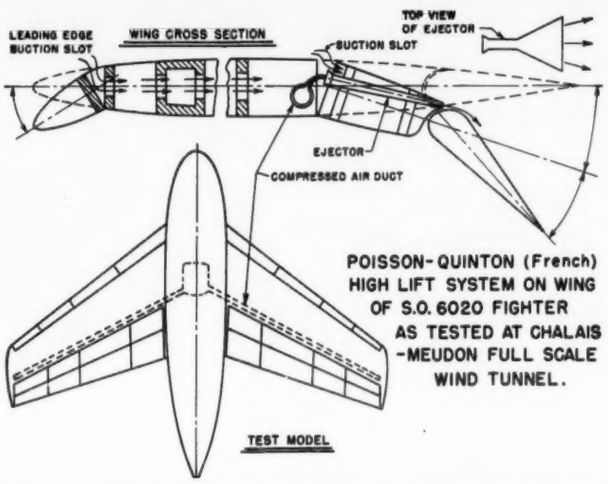

LEADING EDGE SUCTION SLOT
WING CROSS SECTION
TOP VIEW OF EJECTOR
SUCTION SLOT
EJECTOR
COMPRESSED AIR DUCT
POISSON-QUINTON (French) HIGH LIFT SYSTEM ON WING OF S.O. 6020 FIGHTER AS TESTED AT CHALAIS -MEUDON FULL SCALE WIND TUNNEL.
TEST MODEL

Fig. 10: Use of the turbojet to supply blowing air for boundary layer control was proposed by Poisson-Quinton (France) and tested in the wind tunnel on a model of the SO. 6020 *Espadon* experimental jet prototype. The section drawing of the airfoil illustrates the complicated structure of the combined suction and blowing system and shows "droop-snoot" leading edge and double flaps at the trailing edge.

ment reduced the duct sizes considerably. Blowing over the aileron also appeared to solve the lateral control problem prevalent in the earlier AF series which utilized a suction system. The combined blowers were driven by a hydrogen peroxide jet pump made by Walter K. G., of Kiel.

*

Following these examples, and after exploratory wind tunnel tests at the University of Wichita, the Office of Naval Research and the Navy Bureau of Aeronautics tested the Arado system in a converted Cessna 170 light aircraft (Fig. 9), which was later renamed the Cessna 309. The hydrogen peroxide pump was replaced by ordinary combustion chambers with air blower, the hot, high pressure gases from which drove the jet pumps located in the left and right wing halves. Compared with the Cessna 170, the 309 has a 40 % shorter take-off distance, and a stalling speed some 15 m.p.h. lower. However, the weight of the boundary layer control system represents 18 % of the aircraft's normal gross weight.

Immediate investigations directed towards application of the Arado system to modern high-speed military aircraft, however, proved disheartening. An examination of the pumping power and the air quantities required for high-wing-loading aircraft with modern thin airfoil sections and high structural density proved the Arado system imcompatible with modern military aircraft, as neither blower of the necessary power nor the appropriate air ducts can be built into the restricted airframe. The only supply source for the large quantities of air required appeared to be the turbojet. A system in which part of the compressed air from the turbojet compressor supplies the required blowing impulse was proposed by Poisson-Quinton (France) for the SO. 6020 *Espadon* swept-wing experimental fighter and tested in the Chalais-Meudon wind tunnel (Fig. 10). Though both U.S. Navy and American aircraft manufacturers agreed that the complicated structure of the French system precluded its use in existing American military aircraft, calculations confirmed the basic suitability of the turbojet as compressed air producer for the blower system. After "two and three dimensional" tests, Grumman Aircraft Co. and the Allison Division of General Motors

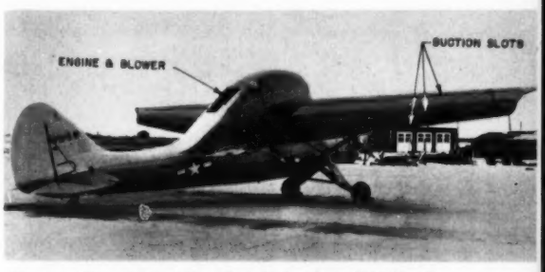


Fig. 11: The wing of the aircraft for boundary layer suction experiments developed by Stalker and the Dow Chemical Co. (U.S.A.) in 1944 had three longitudinal suction slots stretching over the whole span. The engine and blower were housed in the superstructure above the fuselage.

fitted a system working on this principle in a Grumman F9F-4 *Panther* carrier-based jet fighter (Fig. 12). The machine first flew on December 3rd, 1953 and later made more than 30 take-offs and landings on board the aircraft carrier CVA-20 *Bennington,* with reduced carrier speeds, reduced catapult settings and reduced arresting gear settings. It demonstrated a decrease in take-off and landing distances, as well as improved low-speed handling characteristics during simulated wave-offs. The lift increase was equivalent to a 25 % increase in wing area; weight penalty was 50 lbs. Under otherwise similar conditions and at the same take-off speed, the *Panther* could therefore carry an extra 3,000 lbs. payload.

*

Although the lecturer stressed that his remarks represented merely his own private views and were in no way official, they nevertheless reveal important development principles for certain U.S. Naval aircraft. They explain, for example, the background to a report published in *Interavia* No. 5, 1955 that Lockheed is using a boundary layer blower system fed by the turbojet in its T2V-1 Navy jet trainer.

Fig. 12: A Grumman F9F-4 *Panther* carrier-based jet fighter was fitted with a boundary layer control system connected with the turbojet. It gave excellent results in deck tests.

"Wasp Waisted"
TRANSONIC FIGHTERS

Credit for the formulation of the "area rule" belongs to 34-year-old aerodynamicist Richard T. Whitcomb, now assistant head of the Transonic Wind Tunnels Section at N.A.C.A.'s Langley Aeronautical Laboratory. He received the 1954 Collier Trophy for it.

Spring 1952: The engineers were worried. Wind tunnel measurements on a model of the Convair F-102 delta-wing aircraft showed that this aircraft, though designed for supersonic speeds, could never reach Mach 1 with the power plant envisaged, at any rate not in level flight. Drastic order cuts by the U.S. Air Force seemed unavoidable . . .

At the critical moment the Convair design office in San Diego received a *N.A.C.A. research report which described a new method of reducing drag in the transonic range*[1]*:* by narrowing the fuselage in the region of the wings the drag due to shock waves near the speed of sound can be reduced by more than half. Considerably higher performance could thus be obtained for the same engine thrust.

Although the F-102 prototype had already been completed, and production had just begun, the engineers built a new fuselage modified to meet the "aerodynamic recipe" in the N.A.C.A. report. It had a waist-like narrowing near the wing trailing edge and a drop-shaped bulge on either side at the rear. The new version (designation F-102A) was ready about a year later, and in December 1954 Pilot Richard L. Johnson took off on the decisive test flight. At about 33,000 ft. he leveled off . . . and the Convair comfortably pierced the "sound barrier", without buffeting.

First details of this aerodynamic "patent cure" which helped the F-102A across the sound barrier have only just been revealed to the public, three years after publication of the N.A.C.A. report. The essence of the report, however, has long been known to the U.S. aircraft manufacturers, under the name "area rule." As was to be expected, the new structural principles have been followed in the design of other supersonic types, such as the Grumman F11F-1 *Tiger* and the Chance Vought F8U-1 Navy fighters. In N.A.C.A.'s view, the area rule marks one of the greatest advances in aeronautical research in recent years. However that may be, it is clear that N.A.C.A.'s investigations helped at the decisive moment to fill a serious gap in the United States' air armaments.

Credit for formulation of the area rule goes to the 34-year old aerodynamicist Richard T. Whitcomb, now assistant head of the Transonic Wind Tunnels Section at N.A.C.A.'s Langley Aeronautical Laboratory. Whitcomb, who joined N.A.C.A. in 1943 ,had been concerned with basic research into the problem of transonic drag rise. Through this work he came to the conclusion that the total drag of an aircraft near the speed of sound could be successfully reduced only if wing and fuselage were considered as a whole as regards drag behaviour. In other words, the shape of these main components must be mutually attuned so that the interference drag produced by the shock waves due to interaction between fuselage and wings should be as small as possible.

That the fuselage and wings of a high-speed aircraft must be regarded as an aerodynamic whole had actually been known since the early forties, in particular through the work of D. Küchemann[2]). The latter's investigations were continued in Switzerland and applied to the wing-fuselage transition area in Flug- und Fahrzeugwerke Altenrhein's P-16 jet fighter. The first prototype of this aircraft, designed in 1951, showed a narrowing of the fuselage in the wing region. Wind tunnel tests for the design were carried out, at the request of F.F.A., by the Zurich Federal Institute of Technology and the Federal Aircraft Works at Emmen, without knowledge of the work going on simultaneously at N.A.C.A.

Whitcomb had made wind tunnel measurements on a swept wing with central body in 1951, aimed at a systematic analysis of flow and

[1] Richard T. Whitcomb: "A Study of Zero-Lift Drag Rise Characteristics of Wing-Body Combinations near the Speed of Sound", N.A.C.A. Research Memorandum L 52 H108.

[2] D. Küchemann, who today works in the United States, was then attached to German research establishments. He wrote a number of reports on the subject under discussion.

The prototype of the Convair F-102 delta-wing fighter (left) could never have flown beyond Mach 1 with its Pratt & Whitney J-57 turbojet (plus reheat), at any rate not in level flight. By making a "waist" in the fuselage in the region of the wing and adding drop-shaped bulges on the rear fuselage sides drag in the F-102A development (right) was reduced so far in the transonic range that the type can now comfortably exceed the speed of sound with the same power plant.

drag conditions at Mach 1.[3]) He found that the steep drag rise near the speed of sound was due primarily to the increase in these interference drags, which in turn depend on the strength and general configuration of the shock waves. The measurements also provided two further results: 1—shock wave formation near sonic speed is roughly the same for the *fuselage-body* combination as for the body of rotation with similar cross-sectional area curve, i. e., the same axial distribution of cross-sectional areas; 2—the drag behaviour of the wing-body combination is the same as that of a body of rotation with similar cross-sectional area curve.

On the basis of these observations and his own theoretical calculations, Whitcomb concluded that the zero lift drag of any wing-body combination near Mach 1 depends primarily on its cross-sectional area curve. To check his assumption he made a further series of tests in Langley Aeronautical Laboratory's transonic wind tunnel; these provided qualitative proof of his hypothesis and finally led to formulation of the area rule.

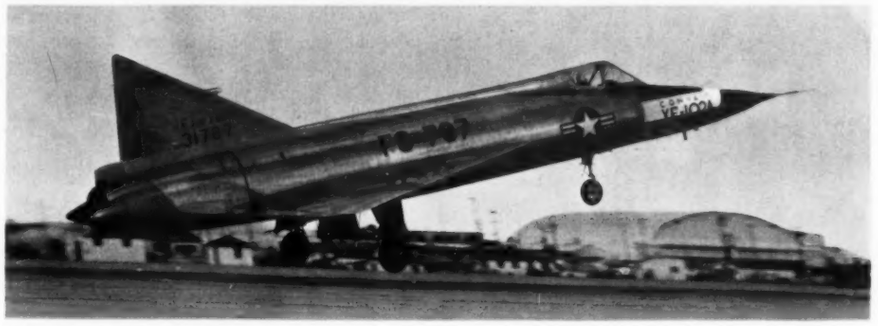
In these tests the flow fields and drag behaviour of four wing-body combinations and four bodies with the same axial cross-sectional area distribution were investigated. To demonstrate practical means of improving performance, the zero lift drags of three special combinations, whose fuselages were narrowed in the wing region, were also measured.

Although quantitative proofs of the relationship between drag rise and cross-sectional area distribution are not yet forthcoming, Whitcomb's results already permit a qualitative assessment of the connection between shape and drag behaviour. As already stated, the interference drag of a body depends on the strength and configuration of the shock waves produced. As the shock waves in turn arise from abrupt direction changes in the flow, all wing-body combinations with a sharp change in cross-sectional area will have greater interference drag than those with a gradual change in cross section. Sharp changes are produced chiefly by the wings. An obvious experiment was therefore to compensate for the disturbing wing cross sections by narrowing the fuselage to such an extent that the combined cross-sectional areas of wing and fuselage correspond roughly to those of the wingless fuselage.

This consideration is the nucleus of Whitcomb's area rule. Expressed in somewhat more accurate terms it means that if the fuselage cross-sections in the region of the wing are so narrowed that the cross-sectional area curve of the whole aircraft approaches that of a low-resistance body of rotation of the same length, then any wing-fuselage arrangement can obtain the optimum drag behaviour of the body of rotation. — However, the area rule is complicated by the fact that the shape of the wing affects the results of narrowing the fuselage. In general it was proved that the drag curve in the transonic range is considerably flatter if the change in wing cross-section area is gradual. On the other hand, a steep increase in cross-section area is less critical than an equally steep decrease. Hence delta and straight wings are markedly inferior to the swept wing as regards drag behaviour in the near-sonic range. For this reason a drop-shaped bulge was added on either side of the Convair F-102A delta fighter's fuselage, to avoid too abrupt a decrease in cross-sectional area (because of the straight trailing edge).

In particular the wind tunnel measurements showed that the additional drag of straight and delta wing models over bodies of rotation is reduced by roughly 60% by putting a "waist" in the fuselage, whereas in the swept-wing case (up to Mach 1.04) it disappears entirely. According to Whitcomb, the incomplete effect of narrowing the fuselage in the straight and delta wing configurations he tested is due in part to the displacement of the stream lines by the boundary layer, a phenomenon that was not taken into account in designing the wind tunnel models. In the swept wing with its much more gradual increase in cross-sectional area this effect was less marked.

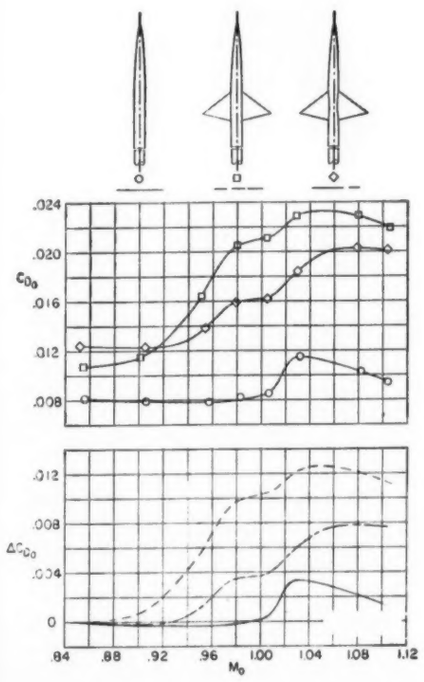
The procedure for designing an aircraft for the transonic range would thus be as follows:



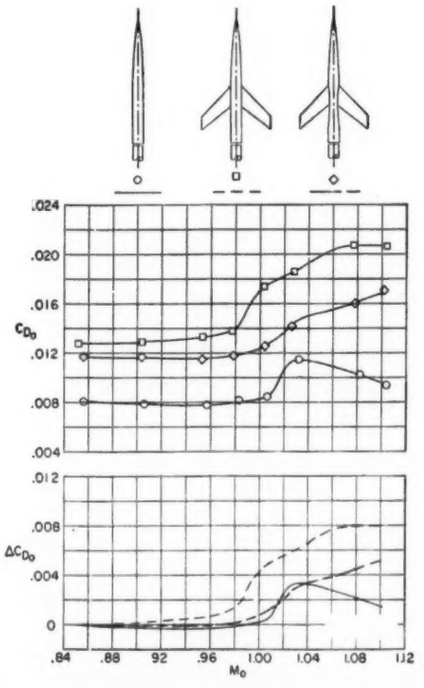
The Convair F-102A delta-wing fighter taking off. The fuselage waist in the rear wing region and the bulges on the rear fuselage sides are clearly discernible.

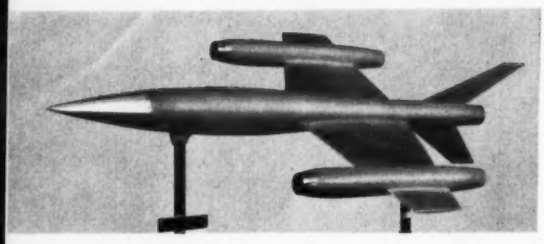
[3] Richard T. Whitcomb and Thomas C. Kelly: "A Study of the Flow over a 45 deg. Sweptback Wing-Fuselage Combination at Transonic Mach Numbers". N.A.C.A. Research Memorandum L 52 D01. 1952.

The drag behaviour of a delta-wing-fuselage combination with and without fuselage waist, compared with a wingless body of similar dimensions. In the upper diagram the drag coefficients of these three configurations at zero lift (C_{D_0}) are plotted against Mach number (M_0). To eliminate the differing effects of friction in the various models the drag coefficients measured at Mach 0.85 are deducted from those of higher Mach number in the lower diagram.



The drag behaviour of a swept-wing-fuselage combination with and without fuselage waist, compared with a wingless body. Here too the drag coefficients measured at Mach 0.85 are deducted from those at higher Mach numbers. Compared with the delta-wing configuration the drag rise near the speed of sound is markedly smaller: not until Mach 1.04 does the drag of the swept-wing-fuselage combination rise noticeably above the value for the wingless fuselage.





To test the area rule in practice, N.A.C.A. made several free flight experiments with this rocket-powered model, measuring in particular drag in the near-sonic range.

all cross-sectional areas are plotted against the fuselage axis, and the curve obtained is compared with that for a reference body of rotation of minimum drag. The cross-sectional area curve for the design is then adapted as far as possible to the reference curve, with due attention being paid to the tail unit, external fuel tanks, weapon pods and any fuselage bulges such as cabin hood etc.

However, the optimum, low-resistance shape can be obtained only for a given speed. In any case, the area rule is designed only for aircraft that are to operate in the transonic range or at moderate supersonic speeds and thus do not have the considerably higher thrusts of real supersonic aircraft.

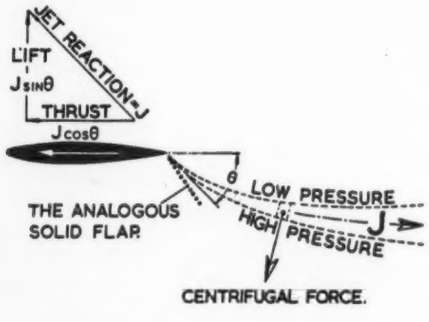
At higher supersonic speeds the area rule no longer applies, for the following reasons: in the near-sonic range the similarity between the shock wave formation on a wing-fuselage combination and that on a body of rotation of similar cross-sectional areas is due to two factors. On the one hand changes in speed near Mach 1 cause only slight changes in the flow section; on the other, pressure disturbances in the propagation of shock waves are concentrated on a plane roughly at right angles to the direction of flow. At higher Mach numbers the flow field takes on a conical form. In addition any change in speed in the supersonic range is associated with a change in the diameter of the stream tubes. Consequently the behaviour of the shock formations in the case of the wing-fuselage combination differs from that on the body of rotation.

The Jet Flap

At this year's S.B.A.C. Display at Farnborough the National Gas Turbine Establishment demonstrated an aerodynamic system described as a "jet flap", which uses the exhaust gases from turbine power plants to increase lift at low speeds. The gases are passed through channels to the wing trailing edge and blown downwards through nozzle-like slots along the whole span. The gas stream emerging at high speed thus forms a continuous jet sheet which modifies the flow round the airfoil to such an extent that hitherto undreamed-of max. lift coefficients can be obtained.

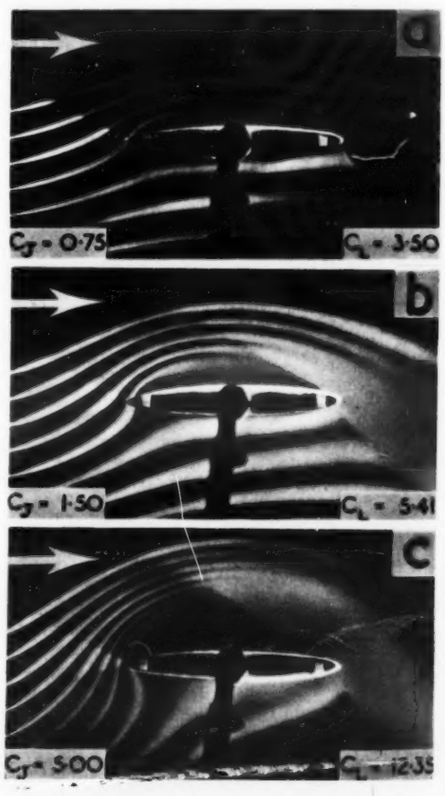
The principle of the jet flap was discovered, more or less by accident, during the development of a jet deflection system for the Gloster *Meteor* single-seat fighter. The mathematical bases are not yet clear, as the extremely favourable measurement results appear to contradict the Kutta-Joukowski theory of circulation. — The unusually high increase in lift achieved by using the jet flap is due to the following circumstances: firstly the downward gas flow produces a thrust component in the opposite direction, which supplies both lift and forward thrust for all angles of the jet sheet between approx. 10° and 80° (in relation to the direction of flight). Secondly the jet sheet causes a marked curve in the flow over the airfoil followed by a deflection of this flow downwards in the jet exit direction, so that—just as with a solid landing flap—a reinforced aerodynamic lift component is created. Finally the gas streaming out of the trailing edge at high speed accelerates the boundary layer on top of the wing, so increasing lift still further. — It is an interesting point that the lift increase due to the jet flap comes to only a small extent from the upward thrust component of the gas stream; the remainder is produced by pressure changes in the flow round the airfoil (Fig. 4). *Thus the jet flap acts as a jet amplifier—the gain it produces is anywhere from three to thirty, depending on speed of flight and blowing thrust.*

Fig. 1: Principle of the jet flap: the gas jet emerging downwards at high speed creates a thrust component (J) in the opposite direction, which supplies both lift ($J \sin\theta$) and forward thrust ($J \cos\theta$). In addition the jet sheet produces a curving of the flow over the airfoil, followed by a deflection of this flow downwards, so that an increased aerodynamic lift also arises. *(British Crown Copyright)*



To check this theory in practice, the National Gas Turbine Establishment undertook a series of wind tunnel experiments using a suitably modified wing model 8 ins. in chord and with a 12.5% thickness/chord ratio (Fig. 3). The wing trailing edge consisted of a removable

Fig. 2: The unusually high lift increase occasioned by use of the jet flap (C_L = lift coefficient) is due mainly to an increase in circulation around the airfoil (super-circulation), as may be seen from the increasing curving of the flow with rising jet coefficient C_J, i. e., with rising jet thrust. *(British Crown Copyright)*



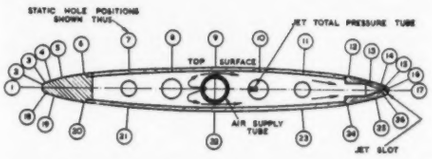


Fig. 3: The wing model (with 26 measuring points) tested by the National Gas Turbine Establishment had a narrow blowing slot (width 0.018 ins.) on the trailing edge, through which the jet sheet emerged downwards at an angle of 58.1°. *(British Crown Copyright)*

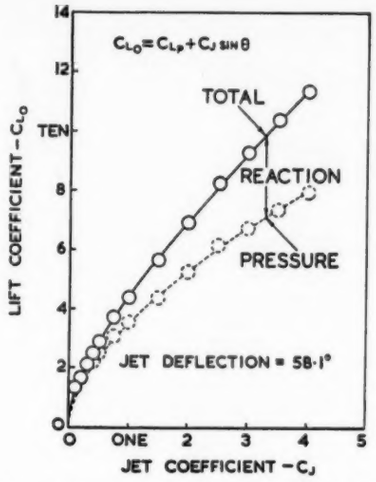


Fig. 4: The increase in lift coefficient (C_{L_0}) with increasing jet thrust comes only in part from the gas jet's upward thrust component (reaction). The major part is due to pressure changes (pressure) in the flow round the airfoil. *(British Crown Copyright)*

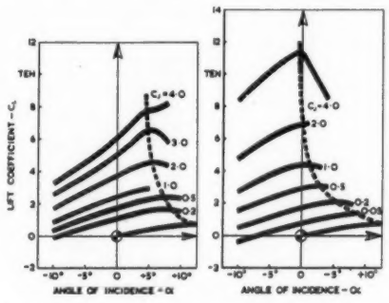


Fig. 5: Results of the wind tunnel tests: lift coefficient (C_L) versus angle of attack (α): *left*, wing model with jet flap at 31.4°; *right*, model with jet flap at 58.1°. *(British Crown Copyright)*

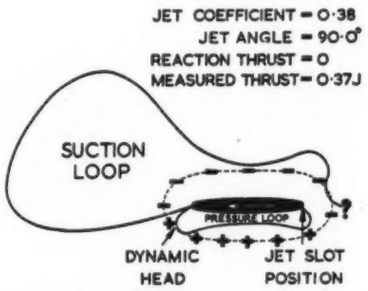


Fig. 6: The radically modified pressure distribution about the airfoil with jet flap produces a thrust component in the direction of flight even when the gas jet is directed vertically downwards, which is due to an extensive negative pressure region (suction loop) far ahead of the wing leading edge. *(British Crown Copyright)*

Fig. 7: Flow diagram for the jet flap wing: the bubble on top of the wing produces a marked curve in the nearest free stream tubes. With increasing angle of attack, however, a situation is reached in which the suction area shown in dotted lines (jet influence sphere) is no longer capable of attracting these stream tubes, so that the bubble bursts and the lift on top of the wing collapses. *(British Crown Copyright)*

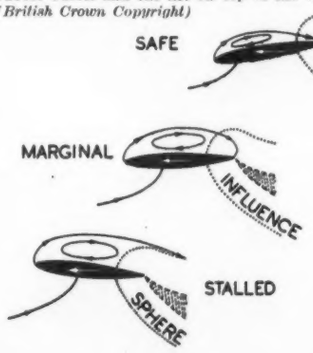


Fig. 8: In the jet flap wing a form of jet control would have to take over the function of ailerons and elevators. Variation in position of the controllable jet deflecting shrouds on the wing trailing edge by means of a control on the joystick would modify the flap angle (by the Coanda effect) until the desired attitude was obtained. The considerable travel of the centre of lift during transition from high to low speed (and vice versa) could be trimmed out by a tailplane without elevators. *(British Crown Copyright)*

casting with blowing slot (0.018 ins. wide), through which the jet sheet emerged downwards at an angle of 58.1°. During the course of the measurements the trailing edge assembly was exchanged for others with a jet deviation angle of 31.4° and 90°. In all cases unusually high lift coefficients were obtained (up to 11; see Fig. 5). Moreover it was found that the maximum values were achieved at very small, or even sometimes at negative, angles of attack, not at high angles as in the case of conventional landing flaps. Thus an aircraft fitted with jet flaps could retain the same attitude at high and low speeds, which would facilitate take-off and landing.

The most surprising results were provided by wind tunnel measurements on a wing model with gas stream blowing vertically downwards. Contrary to all expectations, the flow over the top of the wing followed the narrow rounded trailing edge, then streamed downwards at right angles to the direction of flight, not returning to its original direction until far below the wing. The fact that the boundary layer did not break away despite the sharp curvature (the radius of curvature was only a few tenths of an inch) is attributed to the Coanda effect[1]. Finally, the experiments with the 90° blowing slot showed that even a gas jet directed vertically downwards produces a thrust component in the direction of flight, owing to the radically modified pressure distribution around an airfoil with jet flap, and in particular to an extensive negative pressure region far in front of the wing leading edge (cf. Fig. 6).

The theory and possible applications of the jet flap are described in an unusually interesting report by I. M. Davidson, of N.G.T.E., the discoverer of the jet flap[2]. The report points out several peculiarities of the new aerodynamic system: whereas in the case of a conventional wing lift can be regulated only by changing the angle of attack, the lift of a jet flap wing can be controlled within a given range of angles by changing the direction of flow or the blowing thrust. By increasing the blowing thrust, lift can in theory be raised indefinitely without any risk of a lift collapse. As the jet sheet is blown out over the trailing edge's whole span, ailerons would have to be replaced by a system of jet control (Fig. 8). The same system could take over the function of the elevators, and the marked travel of the centre of lift during transition from high-speed to low-speed flight (and vice-versa) could be trimmed out by a tailplane without elevators. To improve operating reliability in a jet aircraft with jet flaps a larger number of low-power engines could be fitted (directly in the wing), rather than a small number of high-power engines.

*

The advantages offered by the jet flap, in particular for high-speed aircraft, are obvious. It is pointed out elsewhere in this issue that the only practical way to arrive at the urgently needed reduction in take-off and landing speeds —and hence in runway lengths—is by increasing the max. lift coefficient. According to Davidson's calculations, an airliner fitted with eight by-pass engines of 60,000 lbs. total thrust, with a gross weight of 150,000 lbs. and a wing area of 2,000 sq. ft. would have a take-off length to clear a 50-ft. obstruction of only 350 yards and a landing distance of 500 yards; initial climbing speed 80 knots, landing approach speed 50 knots. The narrow gas exit slot along the whole span would also considerably reduce the noise level of the exhaust gases, compared with circular exhaust nozzles, by shifting the intensity maximum to higher sound frequencies. — However, there are still a number of problems to be solved before the jet flap can be applied in practice. The most important of these are: finding a means of feeding the hot turbine gases to the blowing slots with the minimum losses; avoiding excessive heat radiation from the gas channels into the airframe; controlling the jet sheet; housing the fuel in the wings.

[1] The Coanda effect, familiar to all in the form of the deflection produced in a jet of water by holding a finger against it, is explained by the fact that the edges of any flow seek to carry along with them particles from their surroundings. If a solid body is brought into contact with the flow surface, no particles can be attracted from the surroundings at this point, and the negative pressure thus created deflects the flow in the direction of the disturbing body.

[2] "The Jet Flap", by I. M. Davidson, B. Sc., A. F. R. Ae. S. (National Gas Turbine Establishment), published by the Royal Aeronautical Society, 4 Hamilton Place, London W. 1; price 1 shilling.

Prototype of the new Saab-35 (J 35) *Draken* supersonic all-weather fighter, with Svenska Flygmotor (Rolls-Royce) *Avon* turbojet and afterburner. The wing is of the double delta configuration launched by Saab; there is no elevator unit, though elevons, i. e., combined elevator and ailerons, are fitted on the wing trailing edge.

Double Delta Configuration for Draken

The Saab-35 Draken's first flight

In January 1952 the Swedish aircraft firm of *Svenska Aeroplan A.B.*, of Linköping, began flight tests on an experimental aircraft with double delta wing, designated Saab-210. This was a pioneer step, as no other manufacturers had ever tested this wing configuration in practice.

Speculation that the Saab-210 was the predecessor of a new fighter was confirmed when the *Saab-35 Draken* single-seat jet fighter (Air Force designation J 35) made its first flight on October 25th, 1955. Like the Saab-210, the J 35 also has a double delta wing. The main advantage of this configuration is given as ample room for fuel, military equipment and main undercarriage, with relatively low gross weight. Moreover the double delta wing is said to show favourable drag coefficients at supersonic speed.

The new fighter, developed for the Royal Swedish Air Force, is powered by a Rolls-Royce *Avon* turbojet with afterburner, which is built under licence by Svenska Flygmotor A.B. Equipped for all-weather operation, the *Draken* is reportedly capable of supersonic speed in level flight. Armament is to consist of cannon, rocket projectiles and guided missiles.

It is planned to produce the Saab-35 in substantial numbers, as it is later to replace the Saab-29 as standard fighter for the Air Force . . . provided, of course, that flight testing produces satisfactory results.

A model of the Saab-35 was demonstrated for the first time at the recent opening of a new supersonic wind tunnel at the Flygtekniska Försökanstalt (Aeronautical Research Establishment) at Ulvsunda, near Stockholm.

Leading guests discuss the *Draken*: Social Affairs Minister John Ericsson, Commerce Minister Gunnar Lange and Government Counsellor Henning Fransen, who also belongs to F.F.A.'s management.

A landing brake parachute and a Saab fully automatic ejection seat are included in the *Draken's* standard equipment.

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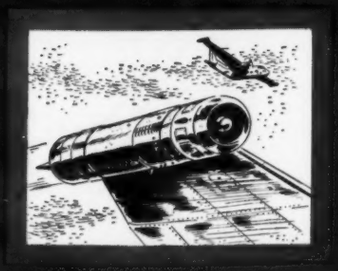

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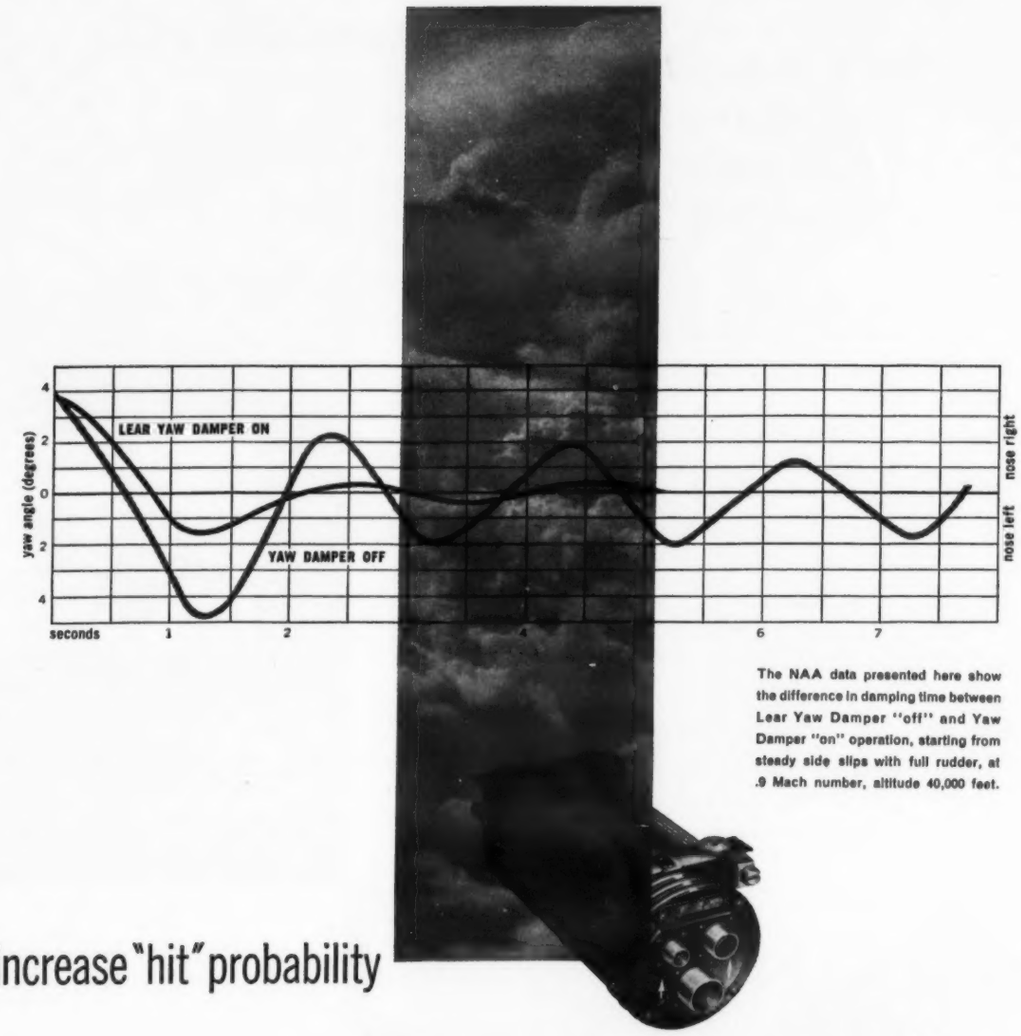

The NAA data presented here show the difference in damping time between Lear Yaw Damper "off" and Yaw Damper "on" operation, starting from steady side slips with full rudder, at .9 Mach number, altitude 40,000 feet.

to increase "hit" probability

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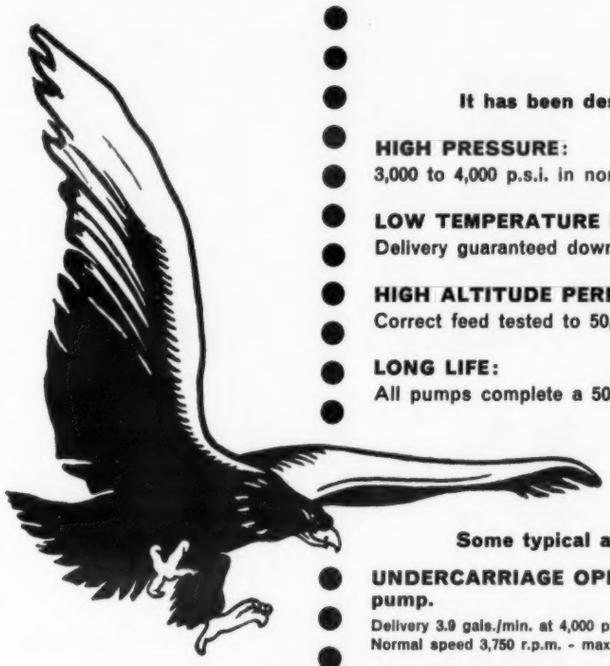

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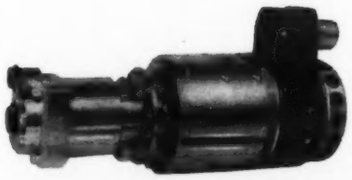

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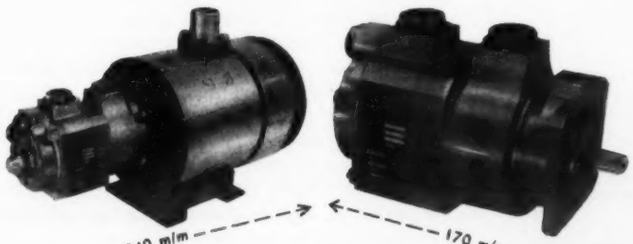

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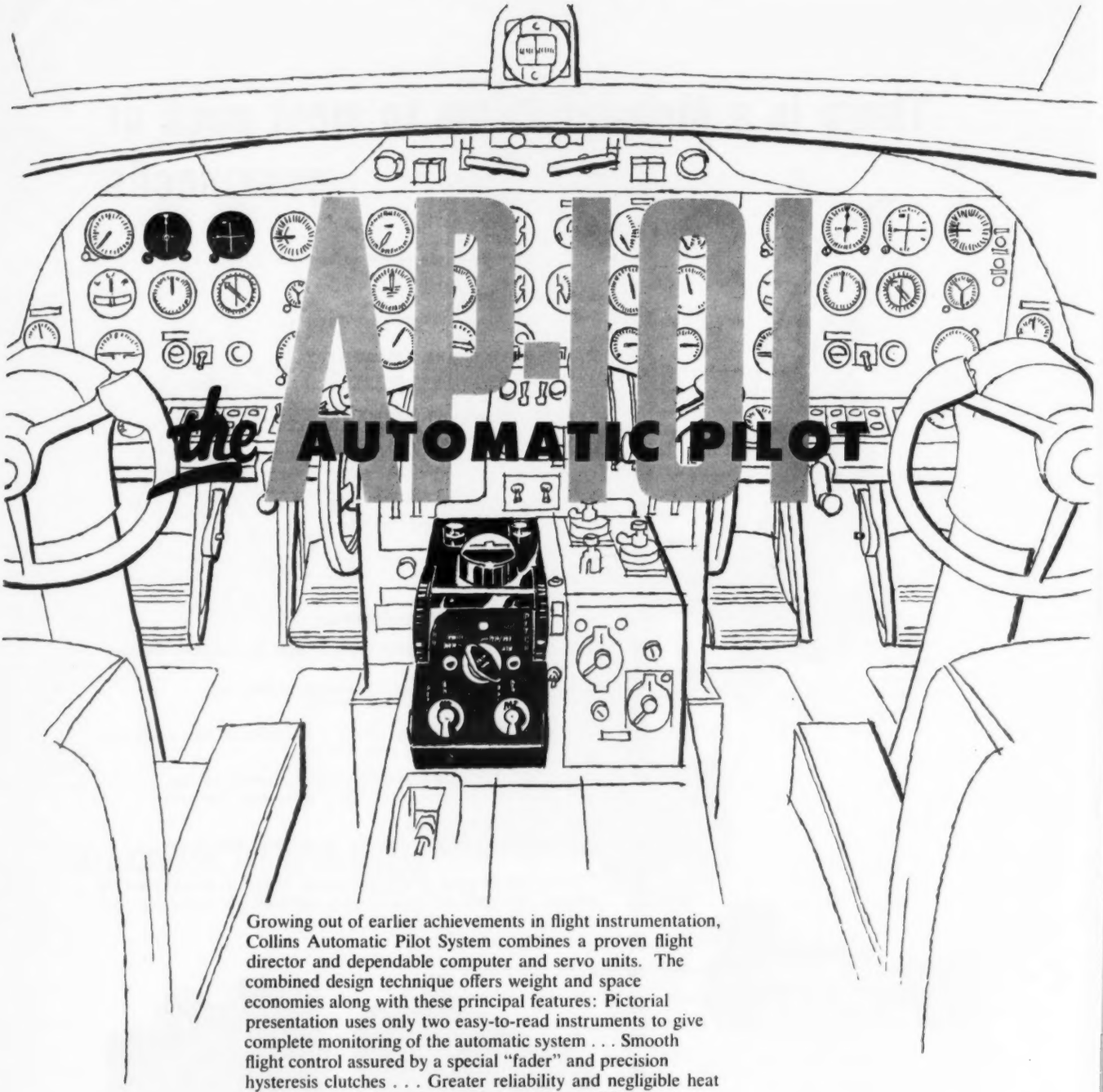

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What's in the Air ? *

AVIATION POLITICS

● Preview of the 1956-57 U.S. defence budget

President Eisenhower, Defense Secretary Charles E. Wilson and Joint Staffs Chairman Admiral Arthur W. Radford have agreed that defence appropriations for the fiscal year beginning on July 1st, 1956 should be at least equal to those for the current year, the Defense Secretary announces. Higher steel prices, rising wages and the extension of the production programme for jet fighters and intercontinental bombers would probably even entail a slight increase.

● Opposition to Swedish economy measures

The Swedish Socialist Cabinet's plans for cutting the 1956 defence appropriations by 65,000,000 crowns (3.4% of the total defence estimates) is meeting with considerable criticism on the part of Army leaders and members of the Opposition.

● Anglo-Russian air transport talks

A three-man delegation from Britain's Ministry of Transport and Civil Aviation flew to Moscow in mid-November for talks with the Russian authorities on the possibility of improving air transport relations between the two countries. The delegation was joined a few days later by Lord Douglas of Kirtleside, Chairman of British European Airways, and a group of senior B.E.A. officials.

● Austro-Russian air transport agreement

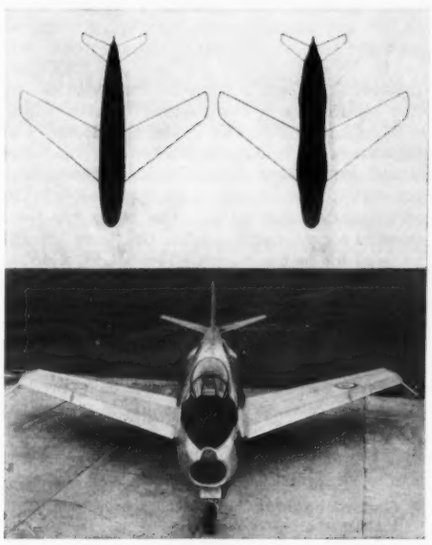
Air Marshal Zhavoronkov, Russia's Director General of Civil Aviation, and Austrian Foreign Minister Figl have signed an air transport agreement in Vienna, giving the Austrian airline, after its establishment, the right to operate direct services to Moscow.

SERVICE AVIATION

● New N.A.T.O. commander for Northern Europe

Lieutenant-General Sir Cecil Sugden, United Kingdom, has been appointed Commander-in-Chief, Allied Forces, Northern Europe. He will take over the post from General Sir Robert Mansergh in mid-January 1956.

Art in the service of airline sales: the Italian Airline Alitalia employed leading Rome artists and sculptors on its new booking office in Beirut.



Experimental version of the F-86 *Sabre* jet fighter with " wasp waist " (cf. article " Wasp-Waisted Transonic Fighters " elsewhere in this issue) built by Canadair Limited, Montreal. Application of the " area rule " led to the addition of bulges at three points of the fuselage: in front of the cabin hood, on a level with the wing leading edge and on either side of the rear fuselage.

● Morocco's Sultan and U.S. air bases

Sultan Sidi Mohammed Ben Yussef has charged that the United States received air bases in Morocco without the previous consent of the Moroccan people. In a statement to the press, the Sultan said that Morocco's constitutional government would re-examine the clauses of the agreement on air bases.

● Egypt permits R.A.F. desert rescue exercise

The Egyptian Government has granted permission to the Royal Air Force Desert Rescue team from El Adem, Libya, to undertake training exercises between Siwa oasis and Sollum. The principal function of the R.A.F. Desert Rescue service is to go to the aid of survivors of aircraft—civil or military and of any nationality—which have made forced landings in the desert.

AIR TRANSPORTATION

● Air transport barriers attacked

In a paper read to members of the Italian Industrial Association Confindustria and the Centre for the Development of Air Transport (Centro per lo Sviluppo dei Trasporti Aerei), K.L.M. Executive Vice-President Dr. Lambertus Slotemaker urged the creation of a joint European air transport market. Unjustified obstacles and discrimination against foreign aircraft did not help to foster national air traffic. On the contrary, such measures were detrimental to a country's own economy because they slowed down normal travel. It was to be hoped, in the interests of air travellers, airlines and taxpayers, that the Strasbourg conference on air transport would lead to a far-reaching liberalization of European air traffic.

● Fleet renewals run into money

To finance the procurement of turbine-powered aircraft a number of U.S. airlines have negotiated substantial loans : American Airlines $75,000,000 (4%, repayable in 1996) from Metropolitan Life Insurance Co. ; Eastern Air Lines $90,000,000 from Equitable Life Assurance Society.

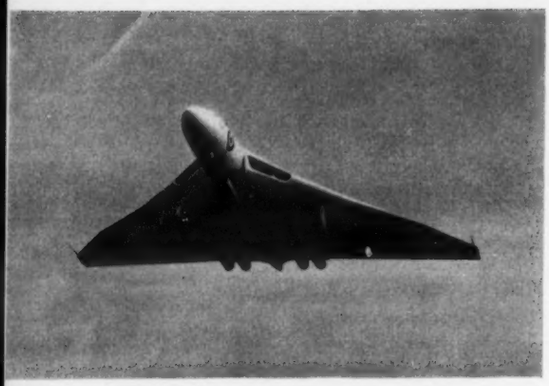
● The " inexhaustable " DC-3

According to the " C.A.A. Statistical Handbook of Civil Aviation ", 1955 edition, there were 1,398 aircraft in operation by scheduled air carriers in 1954. Despite the increasing use of modern types, such as the Douglas DC-7, Lockheed L-1049 and Convair 340, the prewar DC-3 accounted for more than any other types in domestic service : there were 299 DC-3s, compared with 185 DC-6s.

* Extracts from *Interavia Air Letter*, daily international news digest, in English and French. All rights reserved.

A *Canberra B-57B* jet bomber (right foreground) built under licence by The Glenn L. Martin Co., Baltimore, Maryland, on a friendly visit to the English Electric Co. at Warton, Lancashire. In background, left, the British *Canberra Mark 8* version. — Left to right: Lt. L. J. Kaford, U.S. Air Force; F. D. Crowe, English Electric Chief Designer for the *Canberra*; Lt. J. Acton, U.S. Air Force; W. Bullock, European Representative of Glenn L. Martin; Lt. Col. T. J. Price, U.S. Air Force; G. M. Hobday, Aircraft Service Manager, English Electric; Lt. Col. J. R. O'Neill, U.S. Air Force.

During a visit to the Boeing plant at Seattle, Washington, members of the Air France management took part in a demonstration flight by the Boeing 707, which flew at an altitude of 40,000 ft. and a speed of more than 600 m.p.h. Left to right: K. J. Luplow, Manager of the Boeing Foreign Sales Unit; Raymond Dupré, Air France Vice-President and Technical Director; Bryan Wygle, co-pilot for the flight; Max Hymans, Air France President; R. L. Loesch, Boeing Senior Experimental Test Pilot; Louis Lesieux, Air France Managing Director; Robert Montarnal, Air France Vice-President and Financial Director; Henri Lesieur, Manager of Air France's North, Central American and Caribbean Division; and Kenneth C. Gordon, Manager of Boeing's Commercial Sales Section.



Second prototype of the Avro *Vulcan* delta bomber.

Convair TF-102A high-power jet trainer with two side-by-side seats.

Engine bench runs with the Fokker F.27 *Friendship* turboprop commercial transport (R.-R. *Darts*).

*

Sikorsky XHR2S-1 twin-engined helicopter.

INDUSTRIAL

● The British aircraft procurement programme

The following brief details are taken from a statement by a Ministry of Supply spokesman on the civil and military aircraft production programme for the coming years : 1) A cutback in arms orders is forecast, though this will not be so drastic as some foresee, as the Government naturally wants a healthy aircraft industry. 2) As regards civil aircraft, the Bristol *Britannia* is making good progress ; however, the 1959 delivery date for the de Havilland *Comet 4* will bring it into competition with the Douglas DC-8, which it cannot rival on the Atlantic. The Ministry is optimistic about the Vickers *Viscount* and the *Vanguard*, the latter of which has been developed entirely as a private venture without Government funds. Procurement plans for R.A.F. Transport Command have been revised, and the order for the Vickers 1000 cancelled. The Rolls-Royce *Conway* by-pass engine, production of which is to continue, will be used in one of the V bombers, probably the Handley Page *Victor*. 3) Military aircraft : the Ministry is satisfied with the Hawker *Hunter*. Gloster *Javelins* will be in service in one to two months time. Interest at present is being concentrated on the English Electric P.1 supersonic fighter, which is to replace the *Hunter* in the squadrons. The next stage of development after the P.1 is the mixed-power-plant fighter (rocket motor plus turbojet). Out of two prototypes—Avro 720 and Saunders-Roe SR.53—the latter has been selected for production, while the Avro 720 will be used for test purposes. The SR.53, a delta-wing design, is believed to be powered by an Armstrong Siddeley *Spectre* rocket motor and a de Havilland *Gyron Junior* turbojet. The vertical take-off Short PD.11 will be ready for flight testing in spring 1956. Finally the Ministry spokesman announced that production of the Vickers *Valiant* would be completed in 1957.

● Record backlog for U.S. commercial transports

Recent major orders for Douglas DC-8 pure jet transports (30 for U.A.L., 25 for P.A.A., 6 for National Airlines, 8 for K.L.M.) and Lockheed *Electra* turboprop aircraft (40 for E.A.L., 35 for A.A.) have given these two U.S. West Coast manufacturers their biggest-ever backlog of civil aircraft orders. Share of commercial aircraft in Douglas' total backlog is more than 20%, in Lockheed's 28%.

Sikorsky XHR2S-1; the nose caps of the engine nacelles open downwards to facilitate maintenance of the two Pratt & Whitney R-2800 engines.

FLYING EQUIPMENT AND POWER PLANT

● The *Fairey FD.2* delta-wing experimental aircraft with Rolls-Royce *Avon* turbojet has a span of 26 ft. 10 ins., a length of 51 ft. 7½ ins. and a height of 11 ft. The FD.2 exceeds the speed of sound in climb.

● An experimental batch of six Folland *Gnat Mark 1* light-weight fighters should be complete and ready for flight testing by mid-1956. One of the six will probably be equipped for carrier-deck employment.—It seems certain that Hindustan Aircraft, of Bangalore, will build the *Gnat* and its Bristol *Orpheus* engine under licence.—Later versions, such as the *Gnat Mark 2*, may be expected to arouse increasing interest in Britain itself. The *Gnat 2* will have a wing of 6% thickness/chord ratio and be fitted with a more powerful *Orpheus* with reheat. Top speeds equivalent to Mach 1.2 in level flight should be attainable.

● The wing leading edge on the Avro *Vulcan* delta bomber's second prototype has been modified in order to " make the fullest operational use of the more powerful engines which will shortly start to be available ", it is reported from London.

● The first *McDonnell RF-101A Voodoo* photographic reconnaissance aircraft are now being delivered to the U.S. Air Force. The RF-101A version largely resembles the *Voodoo's* fighter version and has roughly the same performance. However, it is slightly lighter in weight than the fighter. Three versions of the *Voodoo* are in production : F-101A, an escort fighter and fighter-bomber for Strategic Air Command ; F-101B, an interceptor for Air Defense Command ; and the RF-101A reconnaissance version.

● The first *Convair TF-102A* two-seat trainer (derived from the F-102A delta fighter) is being flight tested at Edwards Air Force Base, California.

● Engine bench runs with the *Fokker F.27 Friendship* twin-turboprop commercial transport have begun. First flight scheduled before the end of the year.

● The new *Cessna 172* four-seater is to be marketed for $8,750. Engine : 145 h.p. Continental 0-300-A. Span 36 ft., gross weight 2,200 lbs., cruising speed more than 120 m.p.h., endurance 4½ hours.

● The *Douglas DC-8* and *Boeing 707* jet commercial transports will both be equipped with engine silencers and jet deflection devices for landing braking.

● Two new versions of the Gloster *Javelin* delta-wing interceptor are announced : *Javelin FAW.4* and *FAW.7*. Both versions are fitted with more powerful A.S. *Sapphire* turbojets. The FAW.4 is already being flight tested, though not the FAW.7.—A new version of the Hawker *Seahawk* is designated FGA.4 (Fighter Ground Attack).—Existence is revealed of a new *Rolls-Royce* turbojet (a private venture ?) the *RB.108*.—*Napier* announces new versions of the *Oryx* gas generator : *NOr.4* of 825 gas h.p. and *NOr.5* of 950 gas h.p.—Finally the following more recent versions of the Bristol *Orpheus* turbojet have become known : *Orpheus BOr.2 and BOr.3* of 4,520 and 4,850 lbs. static thrust respectively.

Situation Report from Bonn

(mid-November 1955)

The West has had to wait seven full months since the restoration of sovereignty to the Federal Republic for visible signs of a resurrected army from its new ally. Up to mid-November 1955 there were no German army uniforms to be seen in the streets, although the press showed pictures of the new uniforms in the summer, provoking very mixed reactions from uniform experts and female observers.

The Germans answer Allied criticism of the slowness of rearmament by reminders that a direct comparison between the defence political situations after the First and Second World Wars is misleading. Whereas after 1919 Germany still had legal cadres in the form of the Reichswehr and its administrative apparatus, there had been nothing of the kind in the Federal Republic. On the contrary, the authorities, out of fear that the military might gain the upper hand, had determined during their theoretical preparations that, though they would have to tolerate such military experts as were really indispensable, they would entrust the decisive influence in all rearmament questions to civilians " untainted " by military experience. Thus a " routine job " became a time-consuming "creative activity", which ignored past experience and followed new paths.

There is, however, one point on which measures taken after both wars resemble each other. The technical side is again not adequately represented in the new Bundeswehr's top organization. The first far-reaching decisions on equipment, for example on aircraft, were made without consulting competent technical advisers, none of whom are to be found so far in either the Defence Ministry or the Ministry of Economics. There has been no lack of warnings that serious mistakes might be made in equipping the armed services and that the necessary close cooperation with the slowly reviving aircraft industry does not exist.

Federal Government

Two significant Federal Government decisions must be recorded as evidence of progress : the recent creation of the *Ministry for Atomic Affairs* and the establishment of the *Federal Defence Council*. The Minister for Atomic Affairs is former Minister Without Portfolio *Franz-Josef Strauss*, who is also second deputy chairman of the Federal Defence Council. The Ministry of Atomic Affairs' competencies include the coordination of all scientific, technical and financial efforts, both official and private, to avoid uneconomic overlapping. The Atomic Affairs Ministry is to create an Atomic Energy Commission—composed of representatives of all interested circles—draft an atomic energy law and examine the possibilities of a European atomic pool. The new ministry is being severely criticized in Bonn : as nuclear fission will for many years remain a monopoly of the research organizations and there is as yet no question of industrial utilization, there is at present no justification for the existence of an Atomic Affairs Ministry, it is maintained.

Dornier Works, Munich, has a post-war design of its own, the Do 27 reconnaissance and communications aircraft, for which a substantial Army order (300 aircraft?) is expected.

The *Federal Defence Council* consists of members of the usual ministries and plans to call in other Cabinet members as needed. Chairman is the Federal Chancellor, whose deputies are first, Vice-Chancellor Blücher and second, Minister Strauss.

The passage of a *Federal Civil Defence Bill* by the Bonn Cabinet may be regarded as a further example of preliminary measures for defence preparedness. Final approval of the Bill by both Houses will take time, however, as the contributions to be exacted from Land governments, local authorities and property owners for the construction of civil defence installations are meeting with opposition.

Personnel screening committee : This committee of thirty persons from all branches of public life was set up to check the suitability of military personnel of the rank of Colonel and above for the future armed services and the Defence Ministry and to prepare directives for the appointment of all ranks below that of Colonel. The original and sole object of this measure was to provide official protection for all officers checked and passed as suitable from subsequent " mud-slinging " by outsiders.

Focke-Wulf, Bremen, is preparing for licence production of the Italian Piaggio P.149 trainer and liaison aircraft.

The aircraft firms of Messerschmitt and Heinkel have agreed on joint licence production of the Fouga CM.170-R *Magister* trainer.

Messerschmitt hopes to be able to produce in Germany the HA. 200-R which he developed in Spain; German designation Me 200.

The firms of Henschel-Flugzeugbau, Weser, Blohm & Voss and Siebel-ATG are jointly to build the Nord 2501 *Noratlas* military transport, for which Henschel has acquired licence rights from the French manufacturers, S.N.C.A. du Nord.

Frontier Defence patrol with three light armoured cars. Most of the Frontier Defence Force personnel will be incorporated in the new cadre units.

Since November 12th, 1955, the Federal Republic has had 101 soldiers, most of them officers for the Defence Ministry. Only twelve officers from the Army and Navy (left and right) and Air Force (centre) appeared at the commissioning ceremony in uniform.

Meanwhile, there is open talk in Bonn of serious differences between the committee and the Defence Ministry. In particular it is said that certain leading officials of the Defence Ministry, at present employed in a civilian capacity, are reported not to have been passed by the committee for appointment to military posts. The committee is even said to have refused to pass them as suitable to remain in their present positions. Defence Minister Blank appears to be opposing any such extension of the committee's competencies. The committee in turn is said to attach considerable importance to these competencies, as it has doubts about the efficiency of some of the persons figuring on the personnel list submitted to it.

However much the activity and effect of the committee is welcomed in Bonn, the time consumed—at a moment when time is precious—by the committee's thoroughness and the reorganization of posts necessitated by its verdicts is not arousing enthusiasm. Incidentally, former soldiers are at a loss to understand why they should be the only ones to be screened and not the Defence Ministry's civilian personnel.

Scientific research

Undisturbed by high-level differences of opinion, scientific research and in particular aeronautical research has long since constructed firm foundations. However, German experts regret that research and technical development in the armament field are not being given the priority they should have today. It is hoped that the Atomic Affairs Ministry and Defence Council will overcome the reserve hitherto shown by the competent Federal authorities and succeed in obtaining a more energetic, uniform execution of projects.

Industry

The firms interested in building aircraft have at last reluctantly got together, though not before the Defence Ministry had evinced a definite interest in specific aircraft types and their production under licence in West Germany. The first target of the Federal Association of the German Aircraft Industry and its Chairman Dr. L. S. Rothe has thus been more or less achieved.

Cooperation has been recognized as inevitable, since it is clear to all that a restoration of the aircraft industry to its former strength is at present out of the question. Coordination is a necessity, as a multiplicity of aircraft manufacturers cannot hope to receive adequate backing from Federal or Land governments. The provision of working capital and plant equipment alone is raising problems which the less wealthy firms cannot solve without assistance. Sooner or later the industry will have to call on substantial outside capital in order to re-equip or expand their production facilities. As, however, many firms are still handicapped by debts incurred on behalf of the defunct Third Reich, their credit situation and hence their ability to engage in industrial production on a large scale depend on how far the Federal Government, as the legal successor to the Third Reich, is prepared to find a solution that meets present conditions.

Until this problem is solved, experts believe that the only possible course of action is to create an overall company in which individual aircraft firms should participate. The parent company should bear a part of the financial risk and take over liability, vis-à-vis the contractor, for the execution of contracts. It would also have to have certain rights of control over the use of the funds made available to it. Finally, it would be responsible for organizing a proper exchange of experience, coordinating organization, creating a purchasing committee, etc.

Defence Minister Blank (centre) with newly-appointed three-star Generals Adolf Heusinger (left) and Hans Speidel.

So far *two production groups, Northern and Southern,* are emerging, with the River Main as the geographical dividing line.

In the *Northern Group* the firms of Henschel-Flugzeugbau, Focke-Wulf, Weser G.m.b.H., Blohm & Voss and Siebel-ATG have joined together into a working group to prepare an initial joint programme, the production under licence of two hundred French Nord 2501 military transports. Henschel has concluded a licence agreement with the Sikorsky Aircraft Division of United Aircraft Corporation and expects to receive orders (probably for the S-58 helicopter) from the Defence Ministry. These helicopters are to be used by the German Army for communications and artillery observation duties. — Focke-Wulf, of Bremen, is preparing to build the Italian Piaggio P.149 under licence, and the Air Force is reportedly planning to order 300 aircraft of this type for training and communications purposes. Preliminary work and supervision of P.149 production have been entrusted to Professor Blume's engineering office. Focke-Wulf has also begun building a prototype of the Bl 500/501 designed by Professor Blume, which it is hoped may later be used as sports aircraft and Air Force trainer. As no firm orders have yet been placed by the Bonn authorities, preparations by the firms concerned are still modest.

Much the same applies to the *Southern Group,* composed of Messerschmitt A.G., Dornier and Heinkel, who are preparing to build the Fouga CM. 170-R *Magister* trainer. — Messerschmitt also hopes to be able to produce the HA.200 which he designed in Spain and which would be designated Me 200 in Germany. According to a report in the "Wall Street Journal" for November 10th, Professor Messerschmitt's Spanish group of designers are also said to have designed a supersonic fighter. Heinkel has concluded a development and delivery contract with the Egyptian Government for a fighter with power plant also of Heinkel production. — The third firm in the Southern Group, the Dornier Works of Munich, has a post-war design of its own, the Do 27, and is only waiting for a Government contract to begin

production of 300 of this army reconnaissance and communications aircraft.

Engine production has at present few attractions for Germany, as the orders for light piston engines (roughly 1,000) likely to be placed during the next four years will be insufficient for economic production. – How far the former aircraft engine manufacturers Daimler-Benz and Bayerische Motoren-Werke are interested in developing turbine power plant is not yet clear.

The armed services

By March 31st, 1956 a total of 6,000 men must be not only enlisted but also sufficiently trained to be capable of incorporating 144,000 volunteers for all three services in the prepared cadre units and immediately beginning their training.

The Federal Chancellor has fixed January 1st, 1956 as " D " Day. Within four years of this date the agreed number of German Army divisions and Naval units, and a year later the completely equipped and trained Air Force squadrons should be in existence. This programme is regarded in military circles with some scepticism. It is considered very doubtful whether 650,000 men and modern equipment can be available in time.

However that may be, the Ermekeil Barracks, headquarters of the Defence Ministry in Bonn, has become a hive of industry

West German Atomic Affairs Minister Franz-Josef Strauss.

Dr. L. S. Rothe, Chairman of the German Aircraft Industry Association.

after years of shadow existence. Obvious former soldiers in mufti queue up to register with the Personnel Office. Hoarse officials of the Personnel Section receive hundreds of applicants a day, attempt to discover their aptitude for specific tasks and pass them on as quickly as possible to the Army, Navy and Air Force recruiting offices in Bonn and Cologne. Everything that was formerly " forbidden " now has to be made good within a few weeks.

In recent weeks the reorganization of the Defence Ministry has also reached a " provisional " end. *Under-Secretary Dr. Rust,* who has relieved the Minister of administrative work, will need a little time to acquaint himself with his new responsibilities. The new head of the Personnel Directorate, *Ministerial Director Gumbel,* for many years a colleague of Dr. Globke's, the Under-Secretary of State in the Federal Chancellery, is in the same position. He is faced by serious decisions which have to be taken under pressure, as the Federal Chancellor is pressing for results.

At the moment everything turns on the speed with which former officers and N.C.O.s can be taken on for the recruiting offices that are to be opened in the Länder, for the selection courses to be held shortly and finally for the three initial instructional companies for Army, Navy and Air Force. The Air Force is probably to hold first refresher and training courses for technical personnel at Fürstenfeldbruck near Munich and at Nörvenich, with assistance from the U.S. Air Force and the R.A.F. The Army will set up a training company at Andernach on the Rhine, and the Navy at Wilhelmshaven or Flensburg.

On November 12th Defence Minister Blank gave his blessing to the first 101 former soldiers to be re-engaged under the Volunteers Act and handed over their commissions. These are almost without exception officers for the Defence Ministry, of the rank of Lieutenant Colonel or below. *Generals Heusinger and Speidel* appeared for the first time in the uniform of three-star generals.

W. E.

The Mind of Mr. Reader...

Flying saucers... in Brazil

Sirs,

When developing improvements for the centrifugal blower of a new vacuum cleaner, my subconscious suggested to me the experiment reported in the photo *(fig. 1)*. It worked fine ... The calculation gives the same efficiency as for airplanes. Data are : tangential air speed 8.7 m/sec ; disc surface 490 cm2 ; lift 110 grammes. This was obtained when the centrifugal blower was making 12,000 r.p.m...

What about the theory of this device and the idea suggested by my subconscious ? Let us take two wings and fix them parallel and symmetrical in a rig having in the middle two rectangular mouths blowing wind against the internal leading edges of the two wings ... Each of these parallel wings has lift and drag : lift sums up, drag subtract. At once it is easy to imagine a circular wing and a central centrifugal blower powered by a motor inside a cabin to which the wing is fixed by arms *(fig. 2)*. This is already a flying saucer, nevertheless we have to improve it recalling other old physical principles ... The well-known diagram of pressures around an airfoil demonstrates that the lift of a wing caused by a wind blowing against its leading edge is mostly made by the suction applied on the upper surface of the wing. This effect is explained by the Bernoulli principle. The same lift obtained by difference of pressures applied at the lower and at the upper surface of a wing is obtained if the exhaust of the jet of a gas turbine or the exhaust of a rocket flows

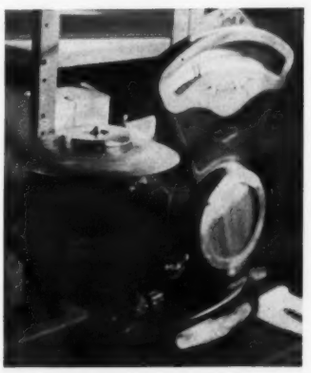


Fig. 1 : Directly beneath the annular exhaust slot of a motor-driven vacuum cleaner blower I fitted a fixed convex disc so that the air emerging from the blower flowed over the upper surface. The whole was set on a balance, and I measured the weight with blower running and stationary.

along the lower surface of a wing ... We had to use different principles to get from a gas flow the " thrust ", which is dynamic, and the " lift ", which is about static...

When we apply the common principles of pressure distribution and curved surfaces combined with the configuration shown in *fig. 2*, we obtain the types of flying machines shown in *fig. 3*...

It is clear that, to avoid precessional movement of the lenticular cabin it is necessary to have two concentric centrifugal blowers rotating one contrary to the other ... A modification of the preceding is shown in *fig. 3*, in which the lift is obtained by the exhaust of a gas turbine in which the compressor is rotating contrary to the turbine casing. The flying machine shown in *fig. 3* would be piloted utilizing the fact that the suspension of the rotating parts inside the lenticular body is made by a universal joint, so making it possible to deviate the jet and modifying the reactions, as is now done in helicopters.

Sao Paulo, Brazil — Ernesto E. Geiger

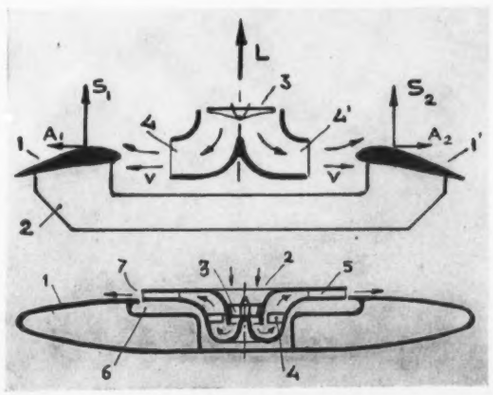


Fig. 2

Fig 3

This letter from sunny Brazil is reprinted without comment. The Editors recommend its study in particular to the American committee which, after years of investigation, came to the conclusion in its 316-page final report that " flying saucers " do not exist.

The GEE System of Navigation

BY P. G. DAY, B.SC. AND K. W. KING, A.M.BRIT.I.R.E., LONDON

Figure 1: Gee Mk. III Viscount Installation.

This article outlines the progress which has been made recently with the GEE system of navigation. This system was used extensively by the Royal Air Force, the United States Army Air Forces, and other Allied Services during World War II. There are described below new airborne equipments, new ground equipments and new interpretation methods which have been developed for civil and military use since that time.

Principles of the System

Gee is a hyperbolic system, that is to say, when signals from two synchronised pulse transmitters on the ground are received in an aircraft at some particular point, the actual time interval between reception of the pulses is dependent upon the differences between the distances travelled and not the actual distances from the ground transmitters. Each point in the service area can, therefore, be defined in terms of the delay between the pulses measured there and all points of equal delay that will fall along a hyperbola. When a series of points associated with a number of specific delays are plotted on a chart, a family of hyperbolae with the transmitters as foci are obtained.

With a second pair of transmitters appropriately spaced a second family of hyperbolae can be plotted. The resulting lattice formed by the two sets of curves then allows any point on the chart to be defined in terms of the co-ordinates of the two sets.

A number of lattice charts are required to cover all areas within the cover of a chain and a new device has been introduced which will stack a set of charts in a container $13'' \times 7\ \frac{1}{2}'' \times 7/8''$. Instant reference to a particular area is achieved by manipulation of the appropriate lever. Pre-flight and en-route references may be written on the plexiglass window, and are easily erased. *Figure 2* shows this new form of airborne chart container.

*

The leading particulars of the Gee System are widely known but for the sake of completeness of this paper two points are worth repeating.

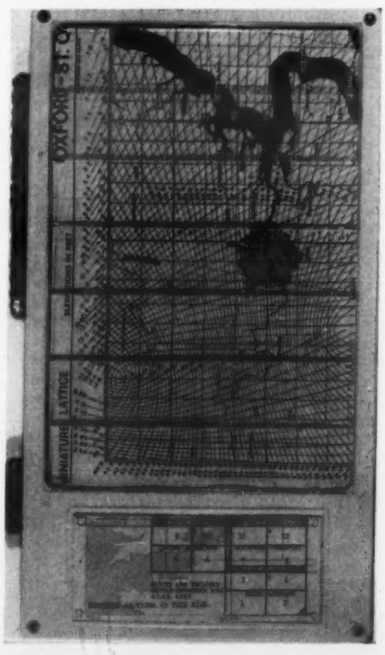
1. As with all V.H.F. systems the distance at which an aircraft may obtain a "fix" depends on a number of factors, but principally, of course, on the height at which it is flying. The distances at which Gee signals are received over land paths, assuming 25 kW peak output from transmitter feeding dipole antenna at 150 metres effective height can be stated as follows:

Aircraft Height	*30 Mc/s*	*80 Mc/s*
30 metres	226 km	185 km
80 ,,	260 ,,	212 ,,
150 ,,	284 ,,	231 ,,
300 ,,	316 ,,	256 ,,
600 ,,	348 ,,	284 ,,
1,500 ,,	410 ,,	348 ,,
3,000 ,,	478 ,,	417 ,,
6,000 ,,	573 ,,	515 ,,
12,000 ,,	720 ,,	652 ,,
18,000 ,,	830 ,,	748 ,,

Recent tests made in connection with the use of Gee for Air/Sea Rescue purposes round the British Isles indicate that considerably greater distances are possible at low altitudes than the theoretical calculation suggests. This point is enlarged on below.

2. Being a pulse system reflected signals from any source whatever (ionosphere, buildings, aircraft, etc.) do not affect the accuracy of the system since they would always be received at some small time interval later than the direct signal. All measurements are made from the leading edge of the pulse which, obviously, cannot be affected by reflected signals arriving later Gee is, therefore, immune from night effects and is relatively easy to site. Mobile and fixed Gee stations were deployed without difficulty on the Continent during 1944 and 1945. Moreover, the new Western European Chains have been sited without trouble arising. In general, the higher the stations, the better the coverage. The U.K. Scottish Gee Chain is a good example of an efficient high ground installation.

Figure 2: Gee Airborne Chart Selector. — Instant selection of an area within the Gee Chain is achieved by reference to the index, and operation of the appropriate lever.



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Extensive operational research has shown that the human eye is a better discriminator of signals through heavy noise and spurious signals than any but the most bulky and complicated systems of electro-mechanical display. This, from a military standpoint is extremely important, and when coupled with the other anti-jamming features associated with a pulse system, it is clear that Gee is superior to other C.W. and beacon navaid systems employing electro-mechanical displays.

During the war, many ships of the Royal Navy and Allied Navies were fitted with early models of Gee receivers and from the operational results achieved over sea paths, it was shown that Gee fixing cover extends well beyond normal radio line of sight paths. Recent tests with aircraft flying at low altitudes have confirmed that reliability can be placed on fixes taken at heights between 200 and 300 ft. above sea level out to ranges between 150 and 200 nautical miles. Further information will be published on this subject in the near future.

Gee cover is at present confined to the British Isles, Northern France and part of Germany but work is well in hand to increase this cover and by the end of 1956 practically the whole of Western Europe and Southern Scandinavia will be within Gee cover.

Recent Developments: Ground Station Equipment

In order that the Gee System shall give high accuracy, the synchronisation of the pulse recurrence frequencies of the ground transmissions must be of a very high order. In the older ground equipment p.r.f. synchronisation was carried out automatically, but the actual phase delay of the Slave Station transmission relative to the Master was held to the required limit by constant monitoring and manual adjustment by a skilled operator.

Figure 3: Auto-Control Equipment, showing negative rail power unit of crystal rack withdrawn and resting on servicing tray.

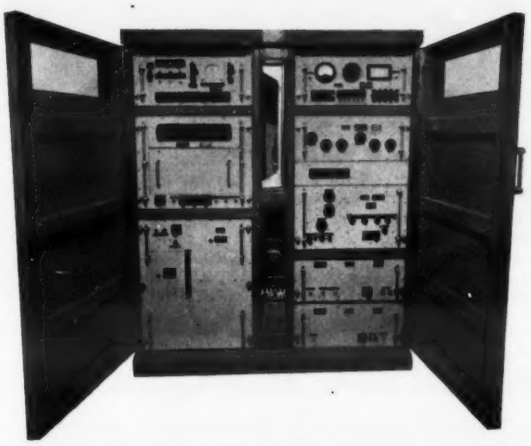

Figure 4: New type 25 kW Gee Transmitter.

The old type Gee Chains were equipped with apparatus of this type.

Clearly a very considerable economy in the cost of manning a Gee chain can be achieved if the ground equipment be made automatic to the extent that constant supervision and manual adjustment are not required. Such automatic apparatus was designed successfully and brought into operation on the Scottish Gee Chain in 1949. Soon after this date the development of another automatic equipment was put in hand ; this embodied the electronic features of the Scottish Chain equipment but utilised the newer and more reliable types of components, valves, etc. Particular stress was laid upon the importance of extreme reliability and ease of servicing and maintenance *(see Figure 3)*.

A new and more compact transmitter *(see Figure 4)* has also been developed ; a special feature of this being the careful design of the pulsing circuits to avoid harmonic and sideband emission. It will be appreciated that interference to services occupying neighbouring frequency channels will be greatly reduced when the newer type of transmitter is used.

Recent Developments: Airborne Equipment

The latest Gee airborne equipment is known as Gee Mark III ; this is a development of the very familiar Gee Mark II of which 50,000 were manufactured during the war. It is designed for cockpit mounting of the Indicator and remote stowage of the other units, i.e. Waveform Generator and Receiver. All operational controls are mounted on the front panel of the Indicator. *Figure 1* shows a typical Gee Mark III installation in a Viscount aircraft where it is operated by the first or second pilot. The equipment is designed to operate from either 80 or 115 volt A.C. supply at 400 to 2400 c/s, and normal practice is to obtain this from a small motor generator operating from the aircraft 24 volt, D.C. supply.

In Gee Mark III, great strides have been made over earlier models both in ease of operation and reliability. The electrical changes have resulted in improved and quicker operating techniques and the mechanical improvements have allowed more flexibility of installation and improved accessibility for servicing. A special feature of Gee Mark III is that in taking a " fix " the operator merely has to set the strobe controls to align the pulses received from a given ground chain and then read off the Gee co-ordinates directly. Counting of the calibration markers by the operator is no longer necessary. The " homing " procedure is equally simple.

The design of the circuit is such that the accuracy of the co-ordinates read from the strobe controls is quite independent of any inaccuracies associated with variations of component values or with mechanical couplings. This is achieved by the use of a series of inherently stable pulse counting circuits, the counting pulses being derived from the equipment's own crystal oscillator. In the new Gee receivers it is no longer possible to obtain an incorrect " Fix " through miscounting the pips as in earlier marks. The navigator or second pilot, therefore, is never presented with false information. In the Gee System there is no ambiguity due to the inability to identify lanes and at no time does the equipment have to be " reset " in order to provide fresh information. Other features of Gee Mark III :

(a) An automatic electronic synchronisation system is incorporated which ' locks ' the airborne equipment to the ground chain in use.

(b) Anti-jamming circuits included in the receiver greatly reduce the effect of C.W. and wide pulse interference : in fact, a C.W. rejection of 54db has been achieved. Also since the Gee signals are displayed on a C.R.T. the highly discriminatory properties of the human eye enable an experienced operator to obtain results under conditions of very severe jamming.

(c) Ten pre-set radio frequency channels are instantly available merely by operation of a switch on the Indicator Unit.

(d) Six pulse recurrence frequencies are instantly available by operation of a switch on the Indicator.

(e) Servicing and maintenance of the units is very simple since a system of permanent aircraft wiring and back plugging units is used.

(f) The Indicator Unit is designed to operate at air pressures down to that corresponding to an altitude of 11,000 metres, but this does not limit the maximum operational altitude since the Indicator would always be mounted in the pressurised cockpit of high-flying aircraft and the remaining units are designed for operation at heights up to 18,000 metres.

Operational Use of Gee

In this role it is valuable to all types of bombers, tactical and photographic reconnaissance, night fighter and anti-submarine aircraft. Many civil aircraft have found it invaluable. In general, the Gee System has been designed as a medium range navigational aid, and its purposes are :—

(a) To enable any number of aircraft to determine their own positions at any time without the necessity of breaking silence by radiating a radar or radio signal. The second pilot-navigator merely has to set his GEE equipment upon the required Gee chain, align the pulses on the cathode ray tube, note the Gee co-ordinate reading and read his position from the appropriate chart. Time for the operation is approximately fifteen seconds.

(b) To allow aircraft to " home " to any points in the Gee service area. In this case the navigator sets up the co-ordinates of the required destination on the Gee strobe controls and then the aircraft is flown until the required point is reached.

The distances from ground stations at which Gee signals may be received have been mentioned earlier ; the accuracy of a " fix " varies from place to place in the service area however. Clearly, the accuracy is best when two lattice lines cut at or near right angles. An average figure for accuracy is usually taken to be ½ km or ½ % of range from the Master Station, whichever is the greater.

In actual fact, by tracking along a lattice line or even tracking across the lattice, a high degree of accuracy may be achieved. For example, in areas within, say, 100 km of the ground stations, it is possible to use Gee to " home " over the centre of a given airfield, and an experienced navigator is usually able to use the system to enable him to bring his aircraft down over his own airfield in bad weather.

The Gee system is extremely flexible and many improvements are possible. It would, however, be inappropriate to mention present development trends, at least until the practical experimental work and subsequent trials have been carried out.

Book Reviews

An Introduction to the Theory of Aeroelasticity.—By Y. C. Fung.—John Wiley & Sons, Inc., New York, 1955 (English, 490 pages, price $10.50).

Though literature on special problems of elasticity has grown substantially since the war, a comprehensive discussion of them in book form has hitherto been difficult to find. The present book, which deals with the whole theory of aeroelasticity with unusual thoroughness, is therefore all the more welcome.—Volume 7 in a series of scientific works issued by the California Institute of Technology's Guggenheim Aeronautical Laboratory, it collects together important points from the fields of aerodynamics and stress analysis dealt with in earlier volumes. The author bases his text on lectures which he has been giving at the California Institute of Technology since 1948. Although his book is addressed primarily to students, it can be recommended to all design and research engineers interested in extending their knowledge of the manifold problems of aeroelasticity.—Each of the fifteen chapters closes with an extensive bibliography, including references to the latest research results ; this is undoubtedly the most comprehensive bibliography yet published on the subject. Re.

50 Jahre Grenzschichtforschung.—Edited by Prof. Dr. H. Görtler and Prof. Dr. W. Tollmien.—Vieweg-Verlag, Brunswick, 1955 (German, 424 pages, price DM 66).

At the International Congress of Mathematicians in Heidelberg roughly fifty years ago Ludwig Prandtl read his epoch-making paper " On the Motion of Fluids with Very Low Friction ", which was the foundation of the boundary layer theory. To commemorate this event the editors of the present volume invited a number of scientists who have worked on boundary layer research to contribute to a jubilee publication. Some 60 aerodynamicists describe in it the present position in theoretical and experimental boundary layer research. The book contains 44 hitherto unpublished contributions giving new information on a series of unsolved problems : laminar boundary layer flow in compressible and incompressible fluids ; investigations of stability ; temperature boundary layers ; turbulent boundary layer flow ; boundary layer control etc. These results will give not only theoretical research but also practical aviation, shipbuilding and fluid flow engine development a valuable impetus. Re.

Aéro-Electronique.—Published for the Association pour l'Encouragement à la Recherche Aéronautique by Dunod, Paris ; 1955 (French, 846 pages, 7,500 francs).

This book deals with the application of electronics to aviation (communications, navigation, landing, radar, airborne equipment, remote controls, checking and measuring, electronic computers, new equipment). It is, in fact a collection of the papers read at the First International Aero-Electronics Congress, held to organize the cooperation which is becoming increasingly urgent in view of the growing importance of electronics in all branches of aviation. The Congress was attended by aircraft production experts, users of aircraft and missiles and electronics engineers, and the papers read form a valuable source of information for aeronautical engineers, manufacturers of airframes, engines and rocket missiles, service and civil aircrews and communications experts. La.

Start frei—Atlantik.—By Wilhelm Küppers. Verlag Hoffmann und Campe, Hamburg, 1955 (German, 307 pages, price DM 13.80).

The author knows the Atlantic. He began flying it as Lufthansa radio operator in the earliest days of combined sea and air mail. However, the book is by no means limited to accounts of personal experience—although these take up considerable space—but gives young readers a graphic description of the development of international Atlantic air transport... from the old Dornier flying boats via the DC-6B and *Super Constellation* to the jet aircraft of the future. He.

75 Jahre Lorenz. — Commemorative publication by C. Lorenz Aktiengesellschaft, Stuttgart, 1955 (German, 272 pages).

C. Lorenz AG. has here published a beautifully produced commemorative book to mark its 75th anniversary. Giving both a review of the past and a preview of the future, this comprehensive account of the firm's activities is not only an excellent visiting card but also a historical handbook on German radio engineering. Re.

Correction

In the article on the Fokker F.27 *Friendship* in the October issue (p. 776) it was erroneously stated that the undercarriage was hydraulically operated. Actuation is in fact by a Dunlop *pneumatic* system.

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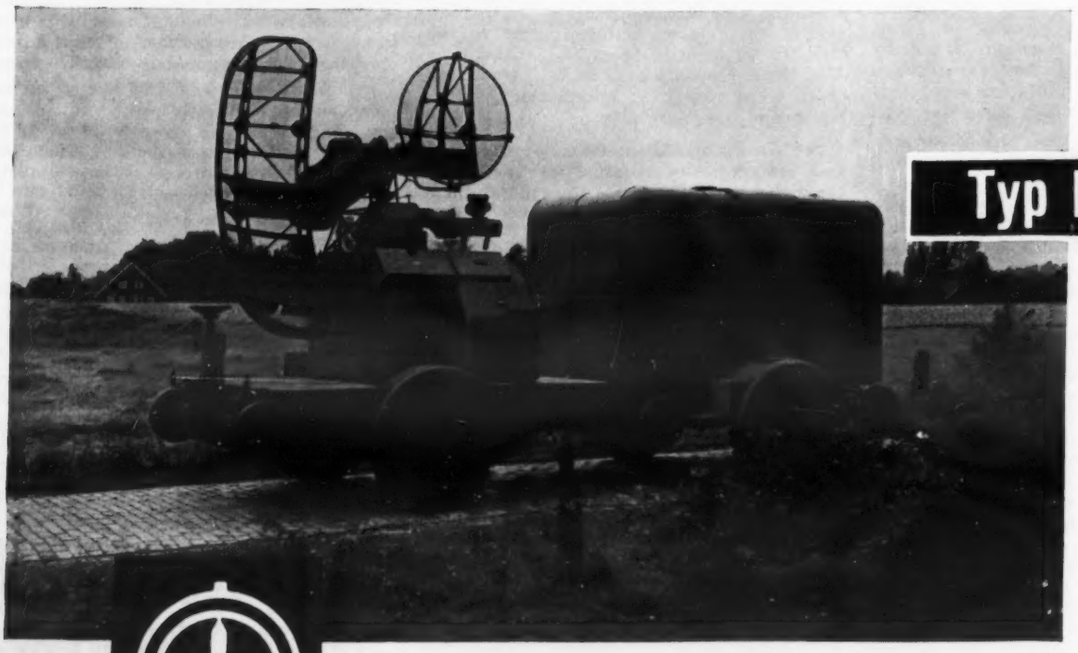

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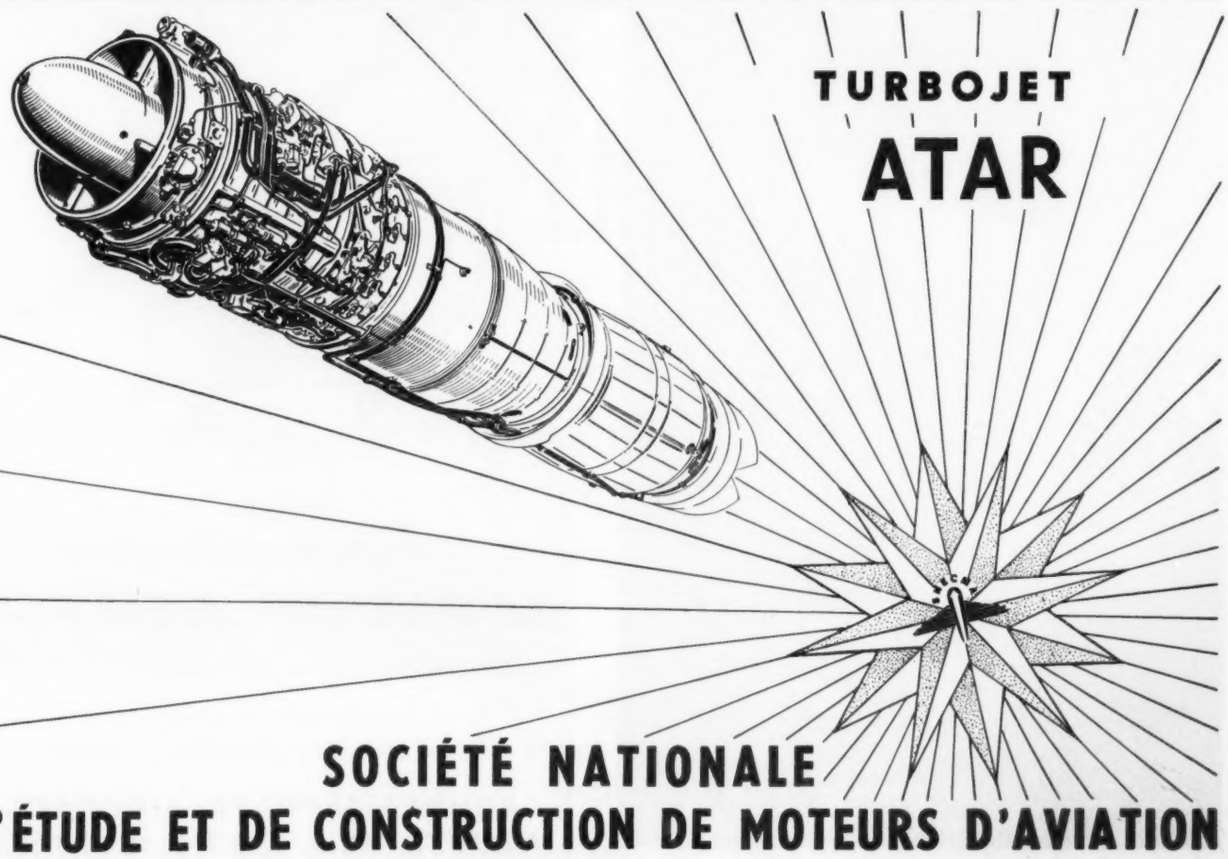

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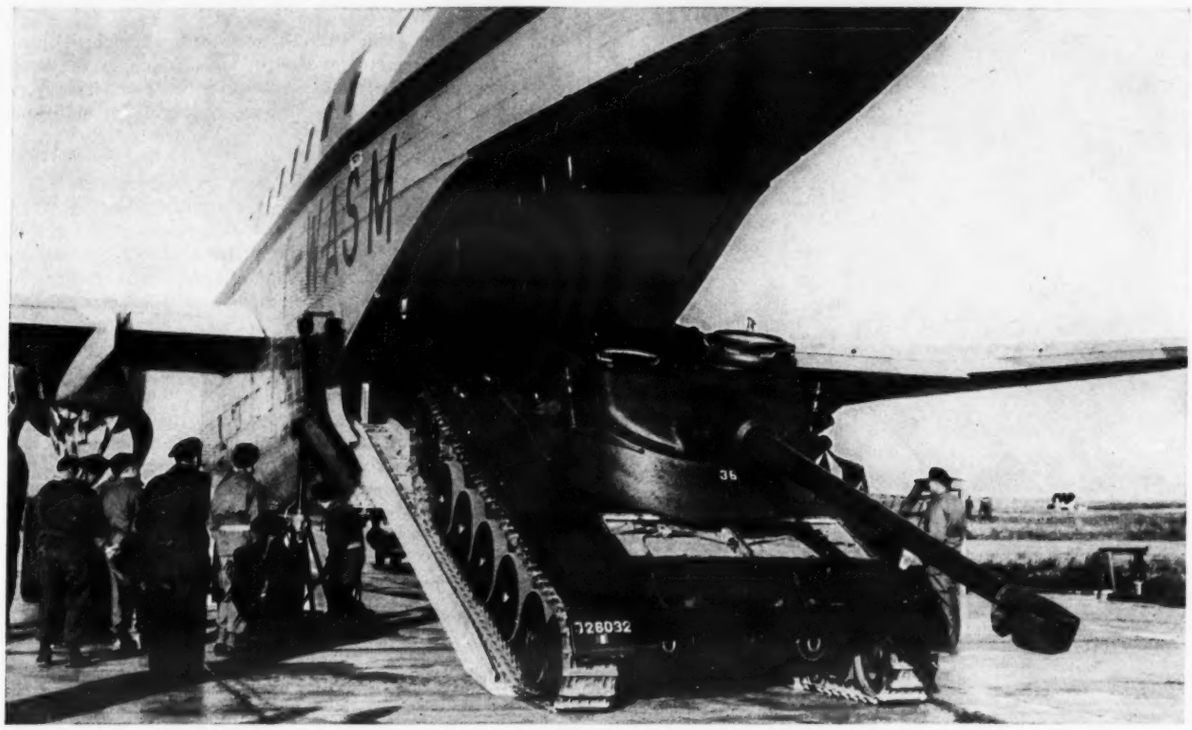

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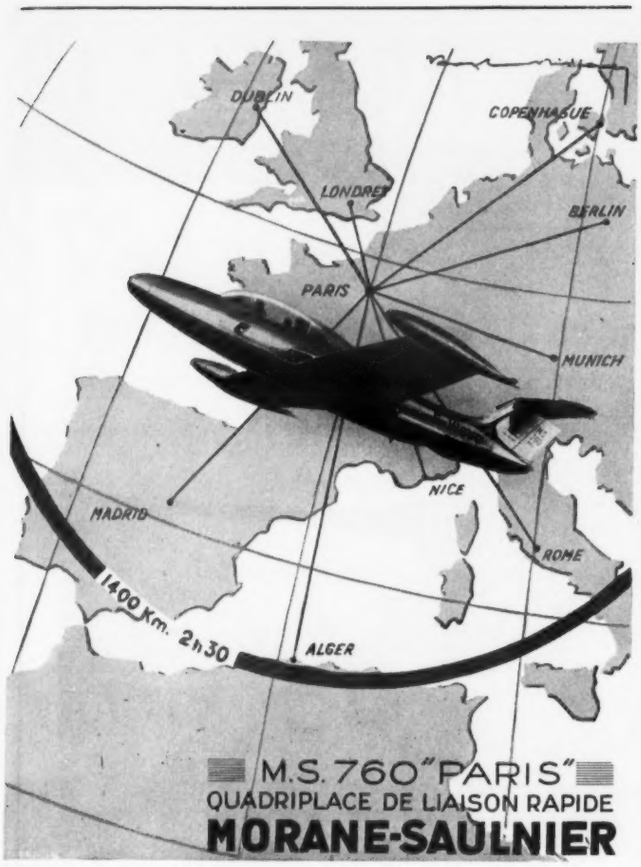

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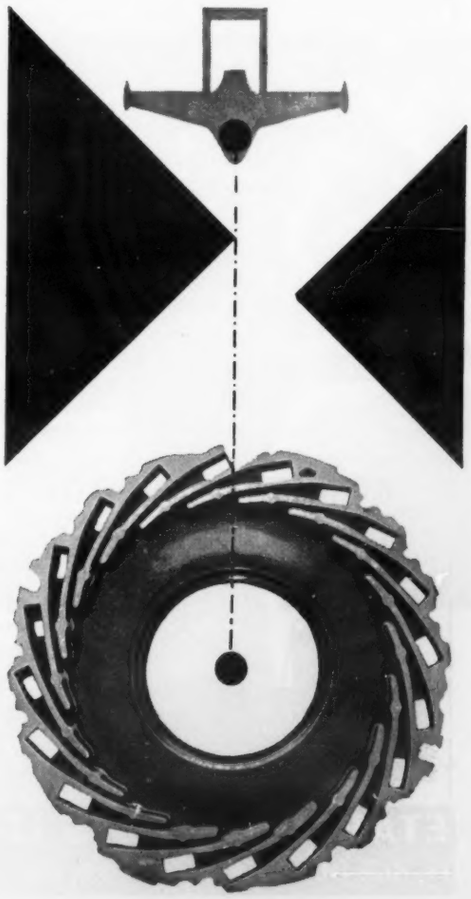

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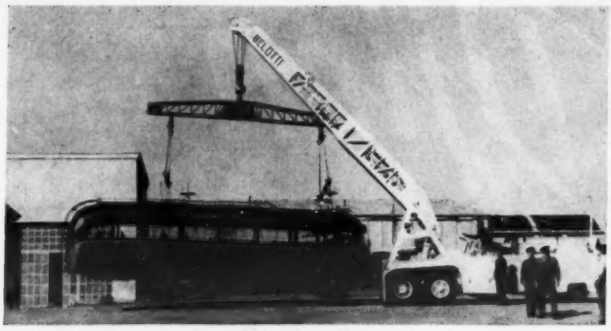

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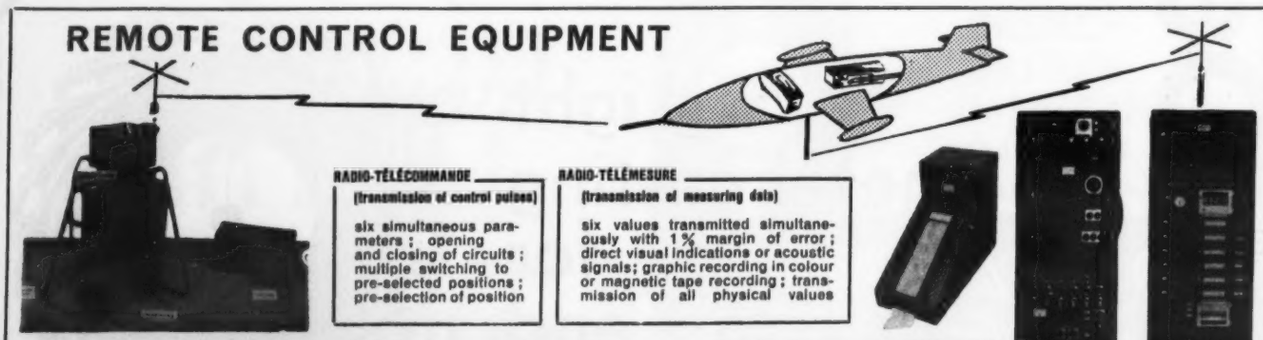

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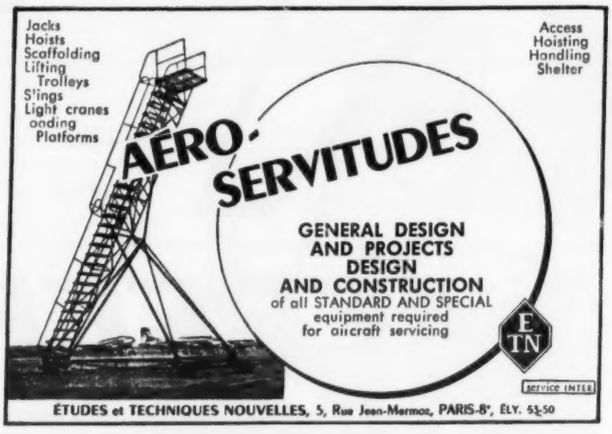

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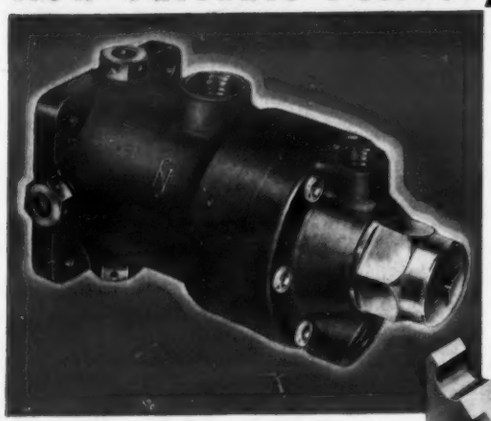

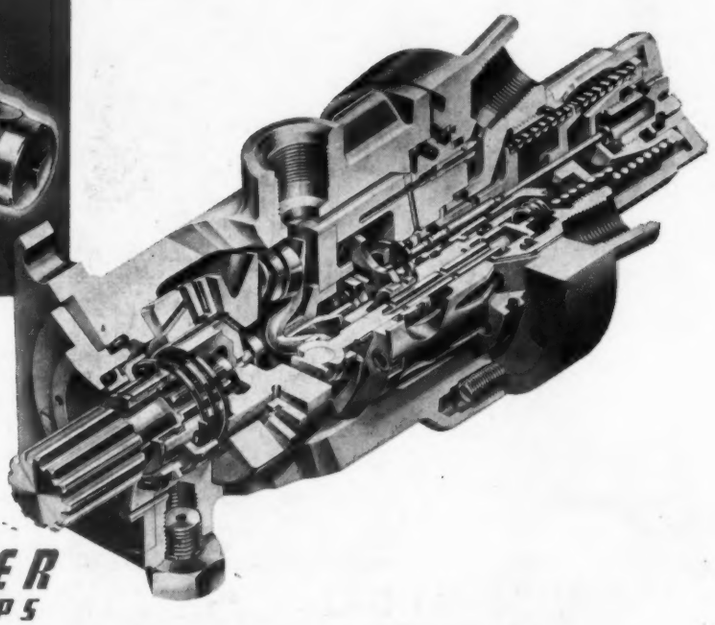

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